No. 1727

FUZES

FOR USE IN

MOUNTAIN, FIELD, SIEGE, AND SEACOAST PROJECTILES

AND IN

DETONATING FUZES

(TWENTY-THREE PLATES)

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FUZES FOR MOUNTAIN, FIELD, SIEGE, AND SEACOAST PROJECTILES.

The following tables give a complete list of the fuzes now used in the service

They are classified under four heads in accordance with their types, as follows: Table I, Ring-resistance fuzes; Table II, Centrifugal fuzes; Table III, Combination time and percussion fuzes; Table IV, Detonating fuzes.

The first column of each table gives the designation of the fuze. The other columns give all the necessary data in connection with the fuzes, including the projectile or fuze stock in which used.

Drawings are appended hereto of each fuze sufficiently in detail to show clearly the construction and method of assembling the fuze when examined in connection with description given in the text.

The following elements are common to all fuzes of whatever class and are essential: The plunger, the firing pin, and the percussion primer.

The composition of the percussion primer of all fuzes now manufactured at the Frankford Arsenal for the service is the same, with the exception of the composition used in delay primers and the concussion primers for combination fuzes.

It is known as the mercuric fulminate primer and consists of the following ingredients in the proportions named:

50 parts glass.
40 parts fulminate of mercury.
20 parts chlorate of potash.
30 parts of sulphide antimony.

A mercuric fulminate primer composition is also used abroad in both the Ehrhardt and Krupp combination time and percussion fuzes.

The composition of the percussion composition in delay action primers and concussion primers for combination fuzes consists of the following ingredients in the proportions named:

Chlorate of potash, 50.54.
Sulphide of antimony, 26.31.
Sulphur, 8.76.
Ground glass, 12.39.
Shellac, 2.00.

This composition was formerly used in the primers of practically all percussion fuzes.

The thoroughly pulverized ingredients are mixed dry, and alcohol is added to dissolve the shellac. The percussion pellets are formed by pressing the mixture while in a plastic state into the percussion-primer recess. Upon the evaporation of the alcohol the shellac causes the pellet to adhere strongly to the metal of the recess.

RING-RESISTANCE FUZES.

Ring-resistance fuzes are made both base and point insertion, and consist essentially of the following parts: The fuze stock or body, the firing-pin sleeve, the split-ring spring, the firing pin, the percussion primer, and the fuze cap.

In general, an auxiliary charge of powder is added to increase the flame from the ignition of the percussion primer.

All ring-resistance fuzes are constructed in accordance with the same general principles.

The plunger, consisting of the firing-pin sleeve and firing pin, is maintained in its normal or unarmed position by the resistance of a split-ring spring of brass.

If sufficient force is applied to the sleeve in the direction of its axis the split ring will be expanded, the sleeve forced to the rear, the firing pin exposed, and the plunger armed.

To insure arming of the plunger when fired, the resistance of the split-ring spring is made less than the force necessary to give the sleeve the maximum acceleration of the projectile.

There are two classes of ring-resistance fuzes manufactured, the "high resistance" and the "low resistance," so called because the arming resistance of the ring is relatively "high" or "low."

High-resistance fuzes are safe under all ordinary conditions of handling and transportation, and are transported fixed in the projectiles in which used.

Low-resistance fuzes are provided with a safety wire, which passes through the percussion plunger and the closing cap This wire is withdrawn immediately before the projectile is fired

All of the fuzes enumerated in Table I, except the M fuze, none of which will probably be issued to the service in future, belong to the high-resistance class, the only low-resistance fuzes at present issued to the service being the percussion element of the 28-second combination fuze, low resistance, and the concussion or time element of all 15, 28, 30, and 31 combination fuzes.

The numbers given in Table I, under the column headed $\frac{W}{R}$, are the numerical values of the ratio of the weight of the firing-pin sleeve in grains to the resistance of the split-ring spring to arming in pounds. This ratio is a measure of the safety of the fuze in handling and transportation; the smaller the value of the ratio the greater the safety of the fuze, and vice versa.

These ratios, for various pieces in service, have been determined by actual firing tests, by means of a specially designed apparatus assembled in shell of different calibers and involving fuze plungers with varying ratios. These plungers were assembled in a way to permit arming in the usual way, and to prevent inverse arming by impact. By inverse arming is meant the forcing of the firing pin forward through the sleeve instead of the sleeve rearward over the pin

All service fuzes are stamped to show the distinguishing letter of designation and place of manufacture. All service point fuzes have a right-hand thread, which, in connection with the right-hand twist of the rifling, causes a tendency of the fuze to tighten in its seat on discharge. For the same reason all base fuzes have a left-hand thread. All point combination time fuzes are staked to the shrapnel to prevent unscrewing. This is accomplished by cutting several notches in the forward end of the shrapnel and forcing metal of the fuze body into these notches. Base fuzes for all mobile artillery are similarly staked.

Just before screwing a fuze into a loaded black-powder shell a light coat of cosmolene should be applied with a small brush to the fuze thread, and the fuze should then be wrenched up tight in its seat. The cosmolene assists to make a gas-tight joint and may serve to prevent a premature explosion in case of failure to remove all loose grains of powder from the fuze-seat thread.

The arming resistance of ring-resistance fuzes is tested in the course of manufacture with a static machine, which gives the weight necessary to force the sleeve over the firing pin against the resistance of the split-ring spring. They are also tested by assembling them in shell and dropping the shell upon a steel plate.

The following description in detail of the "point percussion fuze for 1-pounder and 1.65-inch shell, standard type," applies generally to all ring-resistance fuzes, so far as the important details are concerned

Minor-Caliber Point Percussion Fuze for 1-pounder and 2-pounder Shell, Standard Type (Plate I, figs. 1 and 2).

a, stock, brass.
b, percussion-primer screw, brass.
c, percussion-primer cup, brass.
d, tin-foil disk.
d', primer charge, black powder.

e, percussion composition.
e', primer shield, brass.
f, firing pin, brass.
g, firing-pin sleeve, brass.
h, arming resistance ring, brass.
i, locking groove.
j, closing cap, brass.
k, closing disk, brass.

Assembled as shown on the drawing.

The fuze is made principally of hard-rolled brass. The body, which forms a housing for the parts of the fuze, is struck at the head with a radius corresponding to that of the 1-pounder and 1.65-inch shell in which used. Two slots are formed in the head for a spanner wrench for insertion and removal of the fuzes from projectiles.

The outside of the body is turned and threaded and the interior, after being bored out for the plunger and primer parts, is threaded for the closing screw *j*.

The front end of the plunger cavity is bored out to form a recess for the primer and is threaded with a left-hand thread on the interior for the primer screw. A hole in the top of the primer screw permits the firing pin to strike the primer on impact, and allows the flame from the primer to come to the rear and ignite the shell charge. The primer screw holds the primer cup in place and is provided with two holes for a spanner wrench for insertion and removal. It is locked in place by upsetting a portion of the metal of the primer screw into the thread in the fuze body. The primer cup is .005 inch longer than the recess in the primer screw, so that when the latter is screwed down hard it bears upon the bottom of the primer recess.

The primer cup is the standard type used in percussion fuzes. It has two chambers separated by a solid-vented partition The lower chamber, 0.03 inch deep, holds the percussion composition, and is undercut to assist in holding it in place. The primer shield *e'* prevents any dislodgment of the composition during transportation or by shock of discharge and also restrains the firing pin during flight of the projectile.

In the unarmed or safe condition of the fuze, the split ring rests on the conical slope on the firing pin and sustains the firing-pin sleeve. The resistance of this ring to the expansion necessary to force it over the slope is less than the force required to transmit the maximum acceleration of the projectile to the sleeve. This insures, as already stated, the arming of the fuze in the bore of the gun on discharge.

PLATE-1

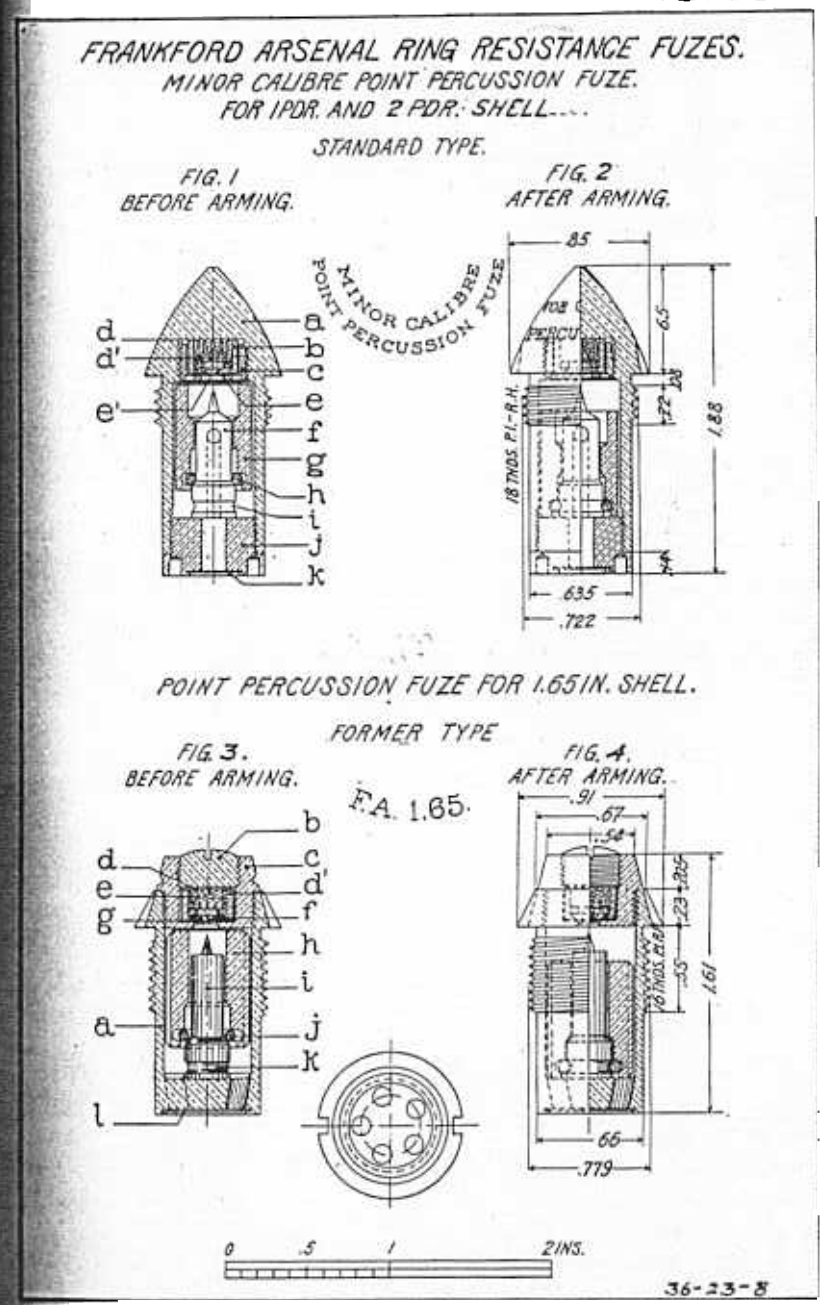
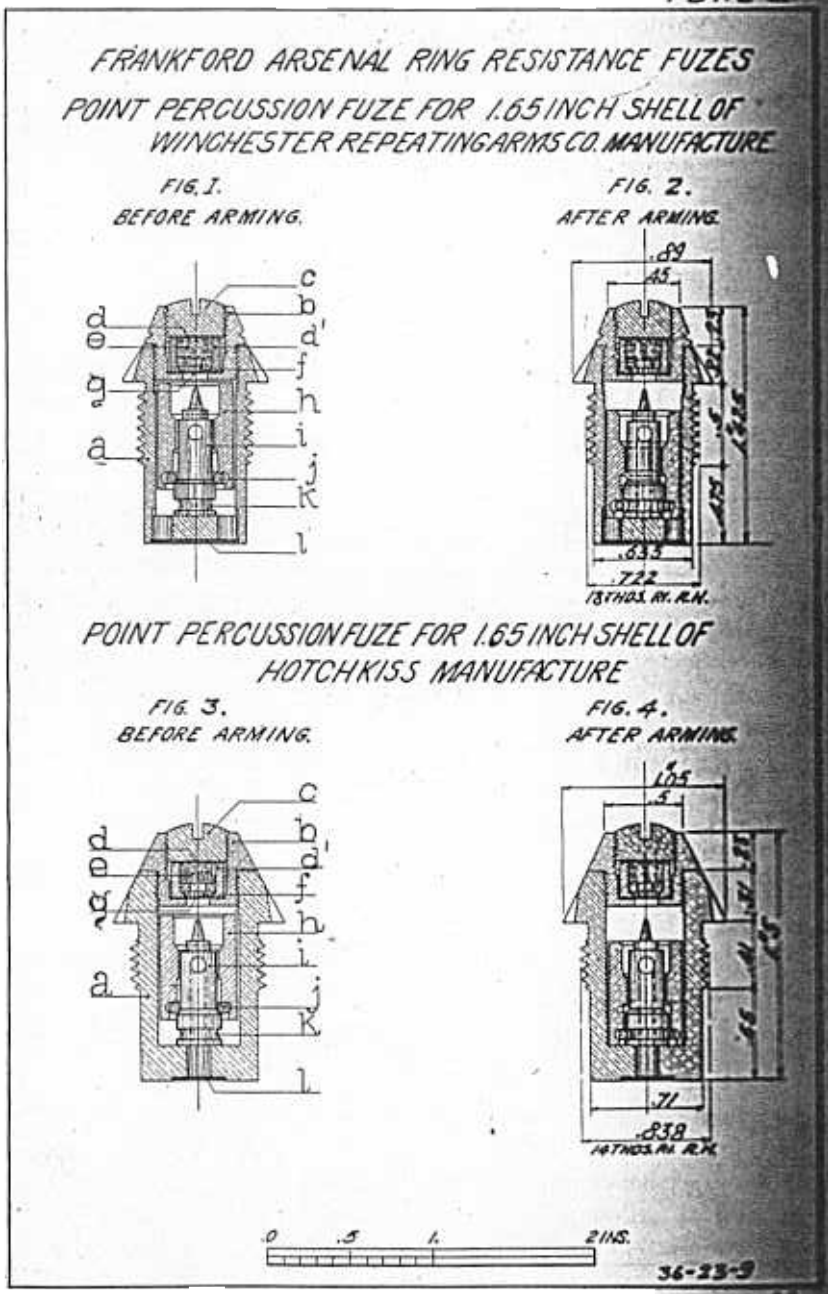


PLATE II.



The counterbored ring recess in the rear of the sleeve requires careful adjustment of dimensions. The diameter at the rear will just receive the unexpanded ring and the diameter of the counterbore will just receive the expanded ring. When the ring rests in the locking groove it has an intermediate expansion sufficient to prevent its withdrawal from the sleeve, and this locks the sleeve and the firing pin together.

The plunger is assembled by slipping the split ring over the firing pin until it rests on the conical slope and then inserting the pin into the sleeve from the rear. The plunger is then placed in the fuze body, pin to the front, and the closing cap screwed down hard and keyed by driving a portion of the sharp lip into a notch in the end of the body of the fuze.

To insure ready passage of the flame from the primer to the rear the front end of the sleeve is counterbored, a hole is drilled through the firing pin at right angles to its axis, meeting a hole drilled through its axis. The closing cap is also drilled centrally and closed by the closing disk, which is held in place by a crimping wall at its edge.

The length of the unarmed plunger is shorter than that of the plunger cavity by from 0.01 to 0.02 inch, so that a slight movement of the plunger is discernible when the assembled fuze is held to the ear and shaken. This is required to insure that the screwing down of the closing cap to its shoulder shall not apply pressure to the upper end of the sleeve, which would tend to force the ring over the slope and arm the fuze.

The act of arming shortens the plunger and increases materially the longitudinal play of the plunger in its cavity. This fact permits a ready and simple means of inspecting for premature arming without dismantling the fuze. A very little practice in holding to the ear and shaking two fuzes, one armed and the other not, will serve to distinguish the marked difference in the play of the plunger.

The action of the fuze when the piece is discharged is as follows: The firing-pin sleeve moves relatively to the rear, for the reason previously stated, and is locked to the firing pin as explained. The point of the firing pin now projects above the sleeve and the fuze is armed, or "ready," as shown in the figure.

As the projectile meets with atmospheric retardation the plunger creeps forward until stopped by the primer shield. When the projectile strikes the pin pierces the shield and the thin layer of percussion composition. The small portion of this composition caught between the point of the pin and the anvil is ignited, firing the primer charge

Point Percussion Fuze for 1.65-inch Shell of Hotchkiss Manufacture, Frankford Arsenal Fuze Elements (Plate II, figs. 3 and 4).

This fuze differs from the standard type just described in the diameter of the outside thread, over-all length, and in the closing cap and primer details.

It consists of the following parts, arranged as shown on the drawings:

a, fuze stock, brass.
b, primer screw, brass.
c, closing cap, brass.
d, tin-foil disk.
d', primer cup, brass.
e, primer charge, powder.
f, percussion composition.
g, primer shield, brass.
h, firing-pin sleeve, brass.
i, firing pin, brass.
j, arming-resistance ring, brass.
k, locking groove.
l, closing disk, brass.

The material used in this fuze is the same as that in the standard type just described.

The fuze body in this case is bored out from the front and threaded for the closing cap, the base being left solid and drilled centrally. The closing cap is bored out to form a recess for the primer cup and threaded for the primer screw, which holds the cup in place.

The number of these fuzes manufactured is limited by the number of 1.65-inch Hotchkiss shell on hand requiring the 0.838 thread, about 3,800.

Point Percussion Fuze for 1.65-inch Shell of Winchester Repeating Arms Company Manufacture, Frankford Arsenal Fuze Elements (Plate II, figs. 1 and 2).

This fuze consists of the following parts, assembled as shown on the drawing:

a, body, brass.
b, primer screw, brass.
c, closing screw, brass.
d, tin-foil disk.
d', primer cup, brass.
e, primer charge, powder.
f, percussion composition.
g, primer shield, brass.
h, firing-pin sleeve, brass.

i, firing pin, brass.
j, arming-resistance ring, brass.
k, locking groove.
l, closing disk, brass.

A small number of these fuzes was manufactured for test in 1-pounder maximum capacity subcaliber shell, for which shell it was originally designed; a sufficient number has also been furnished for the number of 1.65-inch Hotchkiss shell of Winchester Repeating Arms Company manufacture requiring this thread, about 4,600. It is superseded by the 1-pounder and 1.65-inch point percussion fuze, the contour of the latter being superior ballistically.

Point Percussion Fuze for 1.65-inch Shell, Former Standard Type (Plate I, figs. 3 and 4).

This fuze consists of parts corresponding to those given in the description of the fuze for 1.65-inch shell of Hotchkiss manufacture. A sufficient number of these fuzes has been manufactured for the number of 1.65-inch Hotchkiss shell on hand requiring this thread, about 5,000. It is superseded by the minor-caliber point percussion fuze for 1-pounder and 1.65-inch shell, standard type.

Minor-Caliber Point Percussion Fuze for 1.457-inch Cast-Iron Shell for Vickers-Maxim Pom Pom (Plate III).

This fuze is for use only in the 1.457-inch cast-iron shell for use in the Vickers-Maxim Pom Pom. About 33,000 of these shell are on hand in the Philippine Islands. The fuze consists of the parts shown on Plate III:

a, body, brass.
b, closing cap, brass.
c, primer cup, copper.
d, primer shield, copper.
e, percussion composition.
f, primer closing disk, copper.
g, plunger, brass.
h, resistance sleeve, bronze.
j, firing pin, steel.
k, vent cover, paper.

This fuze differs from the ring resistance fuzes in that the split ring is replaced by a sleeve around the plunger, the forward part of the hole being slightly smaller than the diameter of the plunger. The relative positions of the primer and the firing pin are reversed, the primer being inserted in the plunger and the firing pin threaded in the closing cap.

The action of the fuze when the piece is discharged is as follows: The plunger moves relatively to the rear and is locked to the resistance sleeve. The primer in the plunger is now in an armed position. When the projectile is retarded on impact, the sleeve, primer, and plunger continue their forward movement, striking the firing pin and igniting the percussion composition.

Base Percussion Fuze for 1.65-inch Shell (Plate IV, figs. 1 and 2).

This fuze consists of the following parts assembled as shown on the drawing:

a, stock, brass.
b, closing cap, brass.
c, closing disk, brass.
d, primer cup, brass.
e, primer charge.
f, percussion composition.
g, primer shield, brass.
h, firing-pin sleeve, brass.
i, firing pin, brass.
j, arming resistance ring, brass.
k, locking groove.

The action of the base fuze and the functions of its parts are the same as those of the point fuzes, the only essential point of difference being the position of the primer with reference to the shell charge. In the case of the point fuze the flame from the primer has to pass either through or around the plunger from front to rear. In base fuzes the flame does not have to cross any intervening space.

Base Percussion Fuze for 1-Pounder Shell, Former Standard Type (Plate IV, figs. 3 and 4).

This fuze consists of the following parts, assembled as shown on the drawing:

a, body, brass.
b, closing disk, brass.
c, closing cap.
d, percussion-primer cup, brass.
e, percussion composition.
f, primer shield.
g, firing-pin sleeve, brass.
h, arming resistance ring, brass.
i, firing pin, brass.

A limited number of these fuzes was made for use in 1-pounder base-tapped shell. In order to secure uniformity in the fuzes for use in small-caliber shell and at the same time secure greater weight of

PLATE III

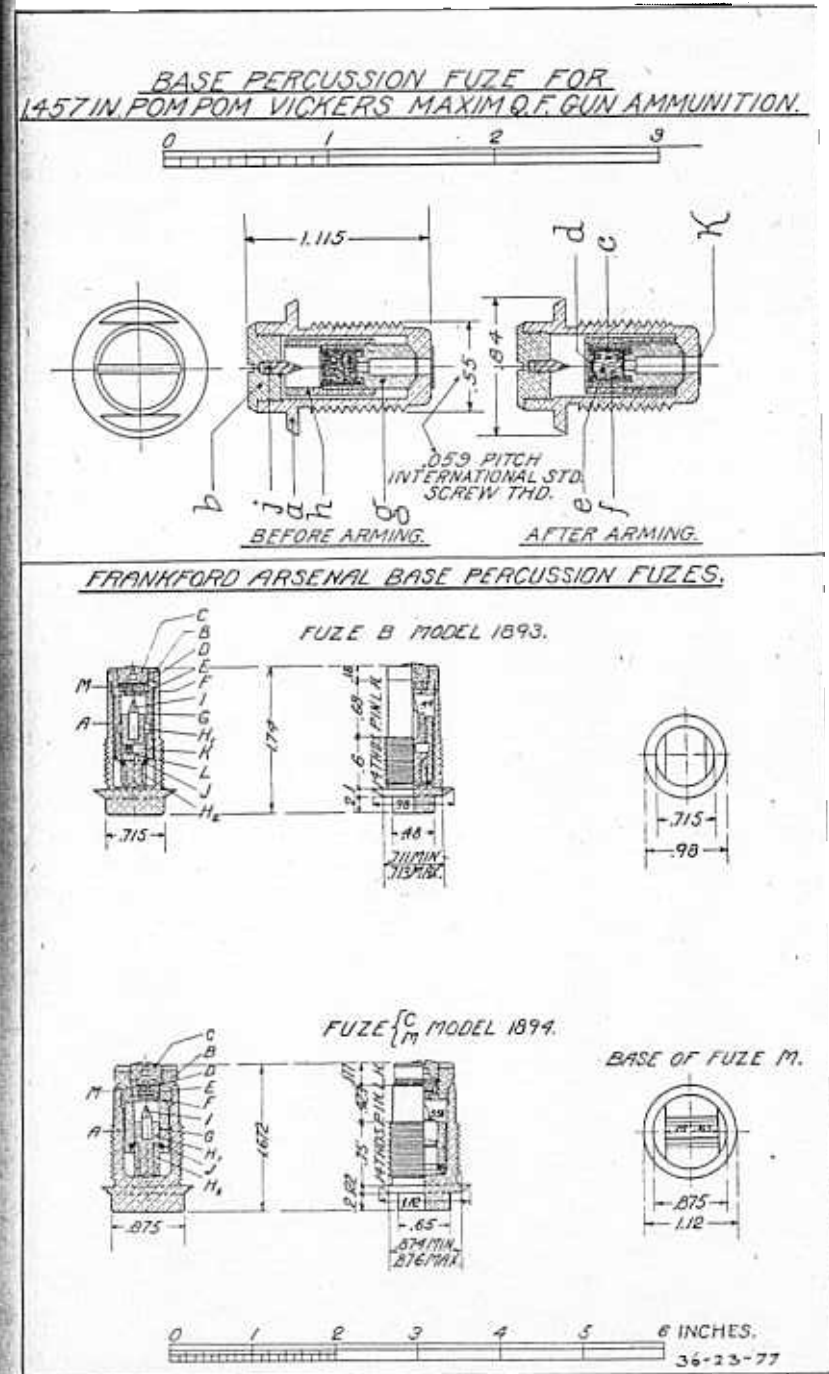
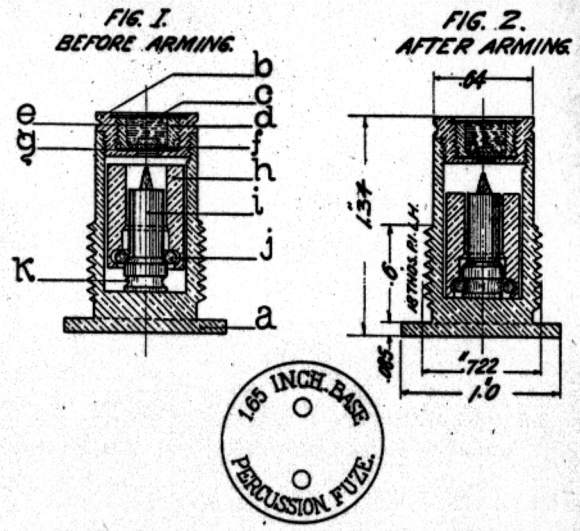


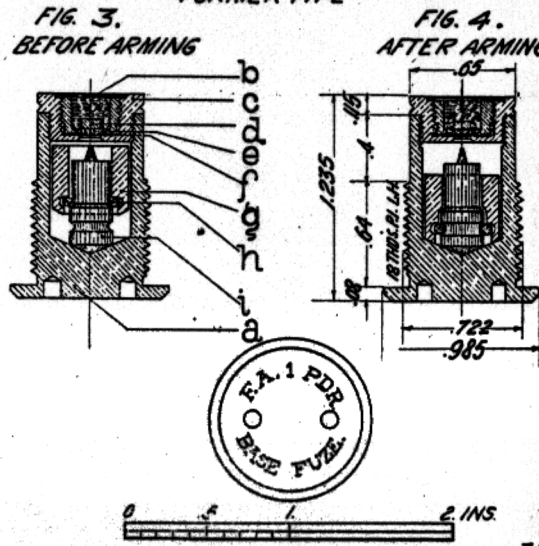
PLATE IV.

FRANKFORD ARSENAL RING RESISTANCE FUZES.

BASE PERCUSSION FUZE FOR 1.65 INCH SHELL.



BASE PERCUSSION FUZE FOR 1 POUNDER SHELL.
FORMER TYPE



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nger this fuze is superseded by the standard type of base fuze 1-pounder and 1.65-inch shell just described.

er-Caliber Base Percussion Fuze for 2.38-inch and 6-Pounder Shell, Standard Type (Plate V, figs. 1 and 2).

his fuze supersedes all those previously manufactured for 2.38- and 6-pounder powder charged shell.

nkford Arsenal Base Percussion Fuzes B, Model of 1893, and C and M, Model of 1894 (Plate III).

These do not differ essentially from ring resistance fuzes of later nufacture. The C fuze was intended for use in 3.2 and 3.6 inch shell and some are probably in service in these projectiles. The ming resistance is so high that they are unsuitable for use in 3.6- h mortar shell. The M fuze is essentially identical with the C ze, except that the arming resistance is so low that it can not be fely transported in projectiles. It was designed for use in the 6-inch mortar shell and was intended to be assembled in the pro- ctile at or near the firing place. It is readily distinguished by two rooves, across the base as shown on the plate. It is doubtful if any fuzes will ever be issued in future, unless 3.6-inch mortar shell ould be so hurriedly issued that there was not time to provide base rcussion fuzes, medium and major caliber. Fuze B, model of 1893; is fuze was superseded by the C fuze described above. A number e in service in 3.2-inch field gun shell. The arming resistance is so igh that the fuze is not suitable for use in 3.6-inch mortars. The sition of the parts before and after arming are shown on Plate III.

Base Percussion Fuze, "High C" (Plate V, figs. 3 and 4).

This fuze consists of the following parts, assembled as shown on e drawing

a, body, brass.
b, primer-closing screw, brass.
b', closing cap, brass.
c, tin-foil disk.
d, primer cup, brass.
e, percussion composition.
f, primer shield.
g, firing-pin sleeve, brass.
h, firing pin, brass.
i, arming resistance ring, brass.

The principal difference between this fuze and those just described that the primer cup is not threaded. The fuze cap is counterbored r the primer cup and threaded for the primer-closing screw. The

PLATE V.

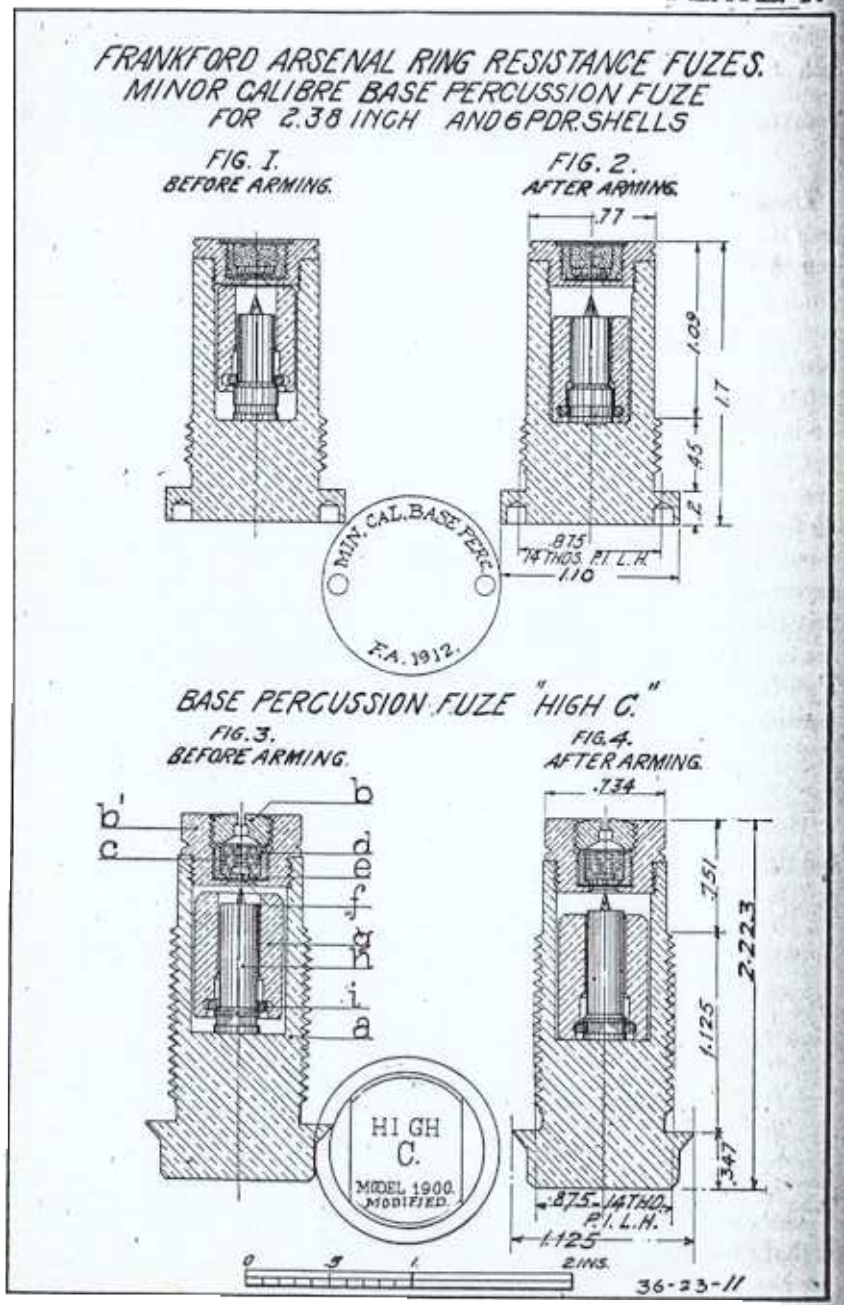
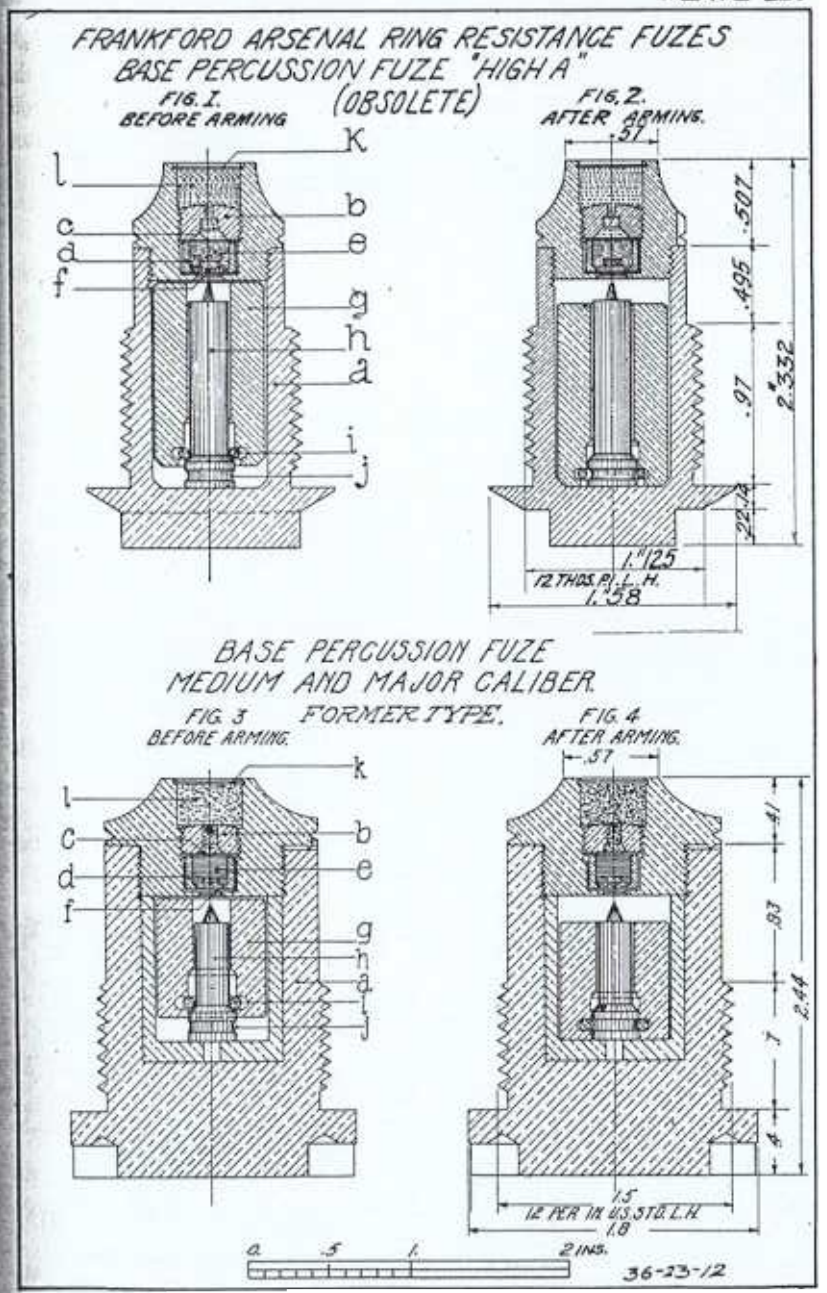


PLATE VI.



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latter is vented as shown to permit the passage of the flame from the primer to the shell charge.

There are no fuzes of this type on hand, but some are probably assembled in older types of ammunition; there are about 28,000 plungers, consisting of the firing pin, the firing-pin sleeve, and the split-ring spring, for which fuze bodies may be manufactured from time to time, when required for projectiles of older manufacture tapped for this fuze.

Base Percussion Fuze, "High A" Model (Plate VI, figs. 1 and 2).

This fuze consists of the following parts, assembled as shown on the drawing:

a, body, brass.
b, primer-closing screw, brass.
c, tin-foil disk.
d, primer cup, brass.
e, percussion composition.
f, primer shield, brass.
g, firing-pin sleeve, brass.
h, firing pin, brass.
i, split-ring spring.
j, locking groove.
k, closing disk, brass.
l, reenforcing charge.

This is an obsolete type of fuze, a few of which still remain in service.

Base Percussion Fuze, Medium and Major Caliber, Former Type (Ring-Resistance Type).

This fuze is shown on Plate VI, figures 3 and 4. It does not differ in principle from the ring-resistance fuzes "High A" or "High C." It is intended for use in powder-charged shell from 2.95-inch to 7-inch, in caliber, when fired from guns giving high accelerations.

All fuzes of this type in store have been modified by substituting Semple plungers for the ring-resistance plungers, thus converting them into a centrifugal type. Those remaining in the service will be replaced by the modified fuzes when renewals are necessary.

Modified American Ordnance Co. Base Percussion Fuze (Plate VII).

This fuze consists of the following parts assembled as shown on the illustration:

a, body, brass.
b, firing pin, brass.

c, firing-pin sleeve, brass.
d, percussion-primer anvil, steel.
e, percussion-primer disk, brass.
f, fulminate composition.
g, percussion-primer housing, brass.
h, fulminate.
j, percussion-primer closing disk, paper.
k, closing cap, brass.
l, plug, brass.
m, resistance ring, brass.

A limited number of these fuzes was made to replace old fuzes made by the American Ordnance Company for use in 2.24-inch projectiles.

The modification consisted in substituting a ring-resistance plunger for a shear-pin plunger and using what is known as the all-fulminate primer in place of the original primer.

Modified Driggs Seabury Base Percussion Fuze (Plate VII).

This fuze consists of the following parts, assembled as shown on the illustration:

a, body, brass.
b, firing pin, brass.
c, firing-pin sleeve, brass.
d, closing cap, brass.
e, percussion-primer disk, brass.
e', percussion-primer disk, brass.
f, fulminate composition.
g, percussion-primer housing, brass.
h, fulminate.
j, percussion-primer closing disk, paper.
k, plug, brass.
l, percussion-primer anvil, steel.
m, resistance ring, brass.

A limited number of these fuzes was made to replace old fuzes made by the Driggs Seabury Company for use in 2.24-inch projectiles.

The modification consisted in substituting a ring-resistance plunger for an old type of centrifugal plunger and using what is known as an all-fulminate primer in place of the original primer.

CENTRIFUGAL FUZES.

The centrifugal fuze of service pattern is the result of a long series of experiments with a view to obtaining a design embracing all the

conditions of absolute safety in handling and transportation and certainty of action.

In the case of ring-resistance fuzes, or any fuze the action of which depends on the longitudinal stresses developed by the pressure of the powder gases in the gun on discharge, the conditions of safety in handling and certainty of action are opposing ones.

It was impossible to meet successfully both sets of conditions in all cases, the stress developed in the direction of the axis by accidental dropping of a fuze being in many cases higher than those developed in the gun.

As already stated under "Ring-resistance fuzes," two classes were necessary, the "low resistance" and the "high resistance," the former being transported in hermetically sealed boxes and a retaining wire used to prevent premature arming, it being necessary to remove the wire before inserting the fuze.

Rapid-fire conditions have rendered it necessary that all fuzes be transported fixed in projectiles, as too much time would be lost under war conditions if fuzes had to be unpacked and inserted during an engagement.

A fuze depending on the centrifugal force developed by the rotation of the projectile was the only solution in case of fuzes for the howitzer and mortar projectiles, the acceleration of which is relatively low.

The centrifugal plunger has been retained also for use in seacoast rifles of calibers larger than 7-inch, owing to the difficulty of designing a ring-resistance plunger which would be safe in handling, and at the same time certain of arming with the accelerations obtainable from those guns.

The fuze body and the primer parts of the centrifugal fuze formerly used do not differ from those of the ring-resistance fuze.

The centrifugal plunger is in two halves which move outward, arming the plunger, under centrifugal force, keeping their faces parallel to each other. The outward motion of the halves is resisted by a spring, the strength of which is governed by the number of revolutions per minute required by the prescribed resistance to arming.

The design of centrifugal plunger mentioned above is known as the "link lift" design.

In this plunger the firing pin is mounted upon an axis, and in the closed position of the plunger points away from the primer, making an angle of almost 90° with the axis of the fuze; in the armed position the pin revolves to a position coincident with the axis of the plunger and points directly at the primer. As soon as the force which causes the plunger to arm ceases to act, the plunger halves close and the pin folds down to its normal or unarmed position.

PLATE VII

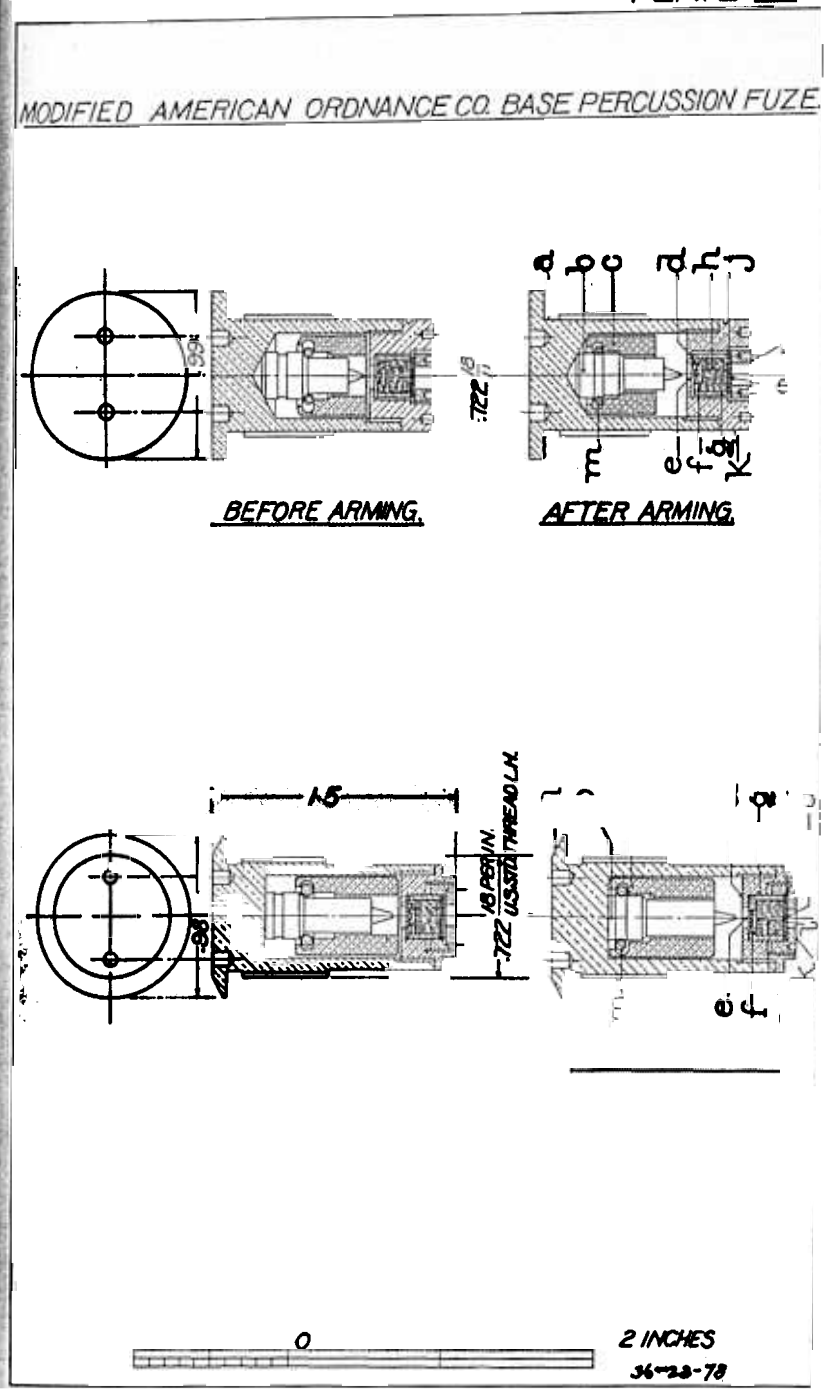
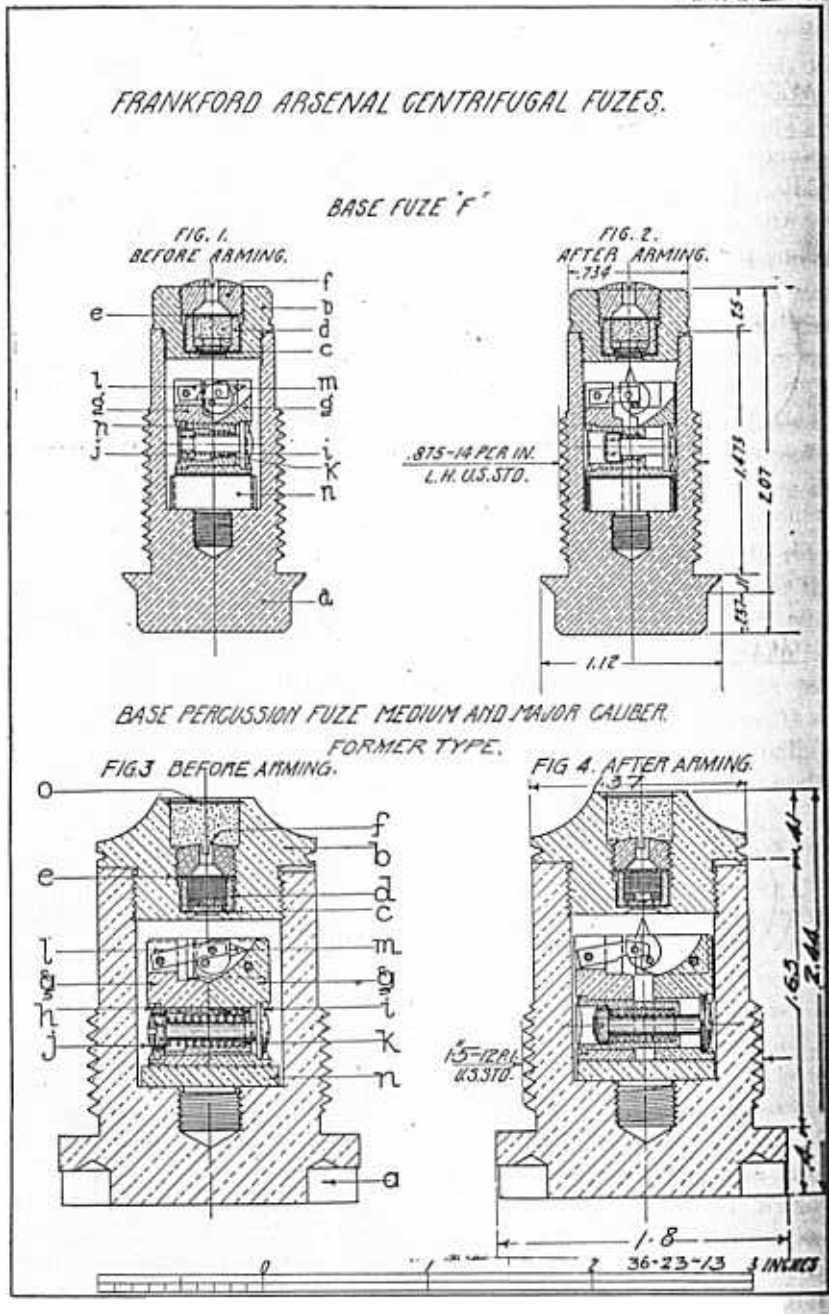


PLATE VIII.



To cause the centrifugal plunger to take up readily the rotation of the projectile due to the rifling, centrifugal fuzes are provided with a rotating device consisting of a stud or fin screwing into the base of the fuze, and engaging in a slot in the plunger, or of a pair of jaws in the bottom of the plunger cavity which engage over corresponding flat surfaces on the plunger.

This plunger has been superseded by the Semple centrifugal plunger, described under "Base percussion fuze, medium and major caliber present type."

All centrifugal fuzes manufactured are tested in a rotating machine to verify their resistance to arming. Samples from each lot are also tested in specially designed jumbling and jolting machines to detect any defects in manufacture or design.

Centrifugal plungers are used in service in the base percussion fuze "F"; in the base percussion fuze, medium and major caliber, when that fuze is used in mountain guns, howitzers, and mortars; in the base detonating fuze, medium caliber, when similarly used; in all base detonating fuzes, major caliber, and as the percussion plunger in the 21-second, 30-second, and 31-second combination fuzes.

Centrifugal plungers are now being used in place of ring resistance plungers in the base fuzes referred to in this paragraph.

The following description of the centrifugal fuze "F" is applicable in its general features to the other fuzes of this design.

The Centrifugal Fuze "F" (Plate IX, figs. 1 and 2).

This fuze consists of the following parts, assembled as shown on the drawing:

a, body, brass.
b, closing cap screw, brass.
c, restraining disk, brass.
d, primer, cup, brass.
e, primer disk, tin foil.
f, primer-closing screw, brass.
g, percussion plunger, brass.
h, percussion-plunger bushing, brass.
i, *j*, arming resistance bolt and nut, brass.
k, arming resistance spring, steel.
l, firing-pin link, brass.
m, firing pin, brass.
n, rotating fin, brass.

The material used in the manufacture of this fuze is principally hard-rolled brass. The closing cap screw and the primer parts are identical with those of the "High C" fuze. The two figures show the plunger before arming and after arming. The plunger *g* is seen to be

composed of two pieces of brass almost semicircular in cross section. From the upper part of the right-hand half a lug projects which fits into a corresponding recess in the other. The firing pin *m* is mounted upon an axis passing through the projecting lug on the right-hand half, as shown on the figure.

The upper end of each half is slotted to receive the firing-pin link and the firing pin. The firing-pin link is pivoted upon an axis in the left half parallel to the firing-pin axis. The other end of the firing-pin link is connected to the firing pin by a crank pin, the center of which is 0.095 inch from the center of the firing-pin axis.

With this arrangement, moving the halves of the plunger outward causes the pin to revolve upward, and vice versa. The radius 0.095 inch of the arc described by the center of the crank pin limits the outward movement of the halves to 0.09 inch to bring the firing pin to an upright position. When in this position the end of the firing-pin link bears on the firing-pin axis, giving rigid support to the firing pin when it strikes the percussion primer.

The outward movement of the halves of the plunger is resisted by the arming resistance spring *k*, which is assembled in the percussion-plunger bushing *h*, under initial compression. One end of the spring bears against the bottom of the bushing *h* and the other against the nut *j* on the end of the arming resistance bolt *i*, so that the tendency is to keep the halves together all the time. When the plunger is in its open or armed position, the nut *j* comes to a bearing against the shoulder shown in the percussion-plunger bushing, limiting the outward movement of the halves to 0.09 inch.

The percussion-plunger bushing *h* is a drive fit in the left-hand half of the plunger and an easy fit in the right-hand half, the clearance in the latter case being 0.001 inch.

The rotating fin *n* engages in the corresponding slot in the plunger halves and causes them to take up at once the rotation due to rifling.

Base Percussion Fuze, Medium and Major Caliber, Former Type (Plate VIII, figs. 3 and 4).

This fuze is similar to the "F" fuze, except that the plunger is shorter and heavier. The device for causing the plunger of this fuze to take up the rotation of the projectile consists of a brass piece in the shape of a pair of jaws fastened in the bottom of the fuze cavity. This fuze is for use in powder-charged shell from the 2.95-inch to the 12-inch, inclusive, when used in guns giving low accelerations.

All fuzes of this type in store have been modified into the present type by substituting Semple centrifugal plungers, a description of which is given below. Those remaining in the service will be replaced by these modified fuzes when renewals are necessary.

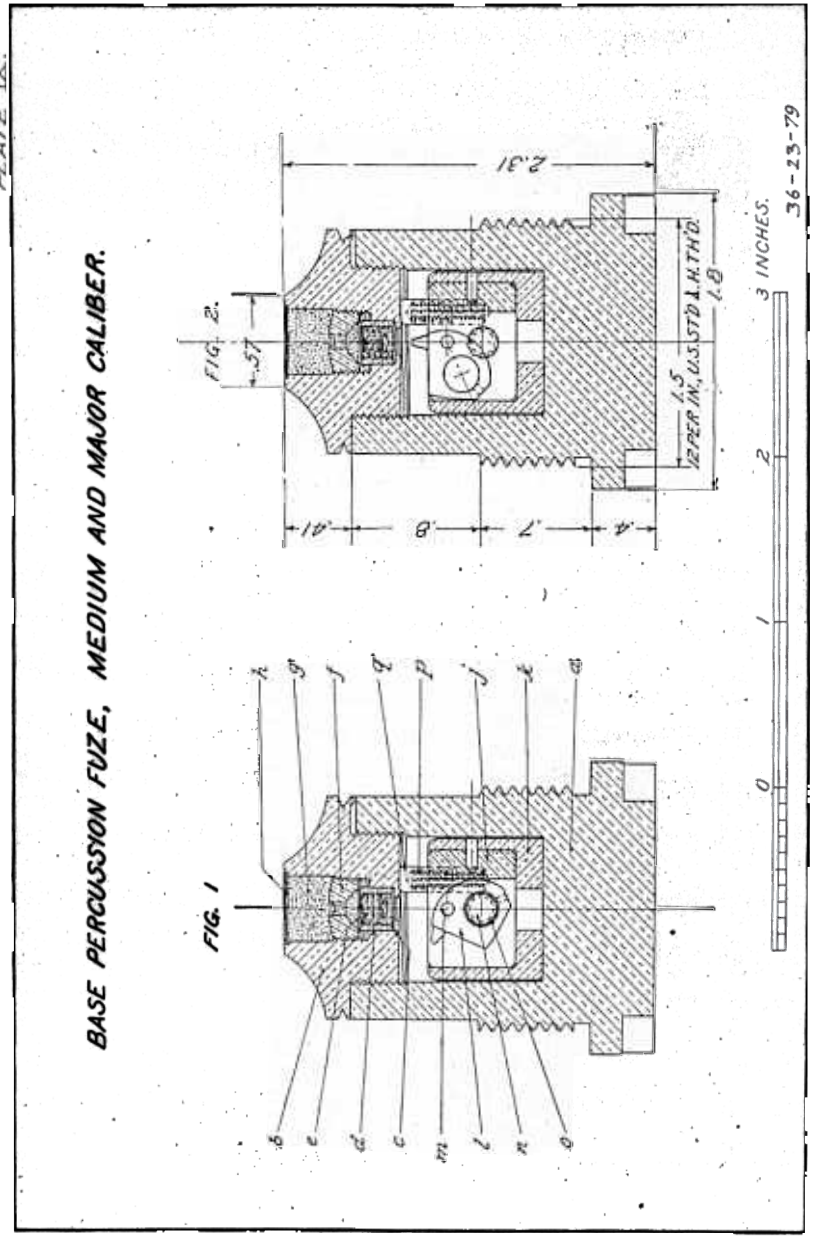


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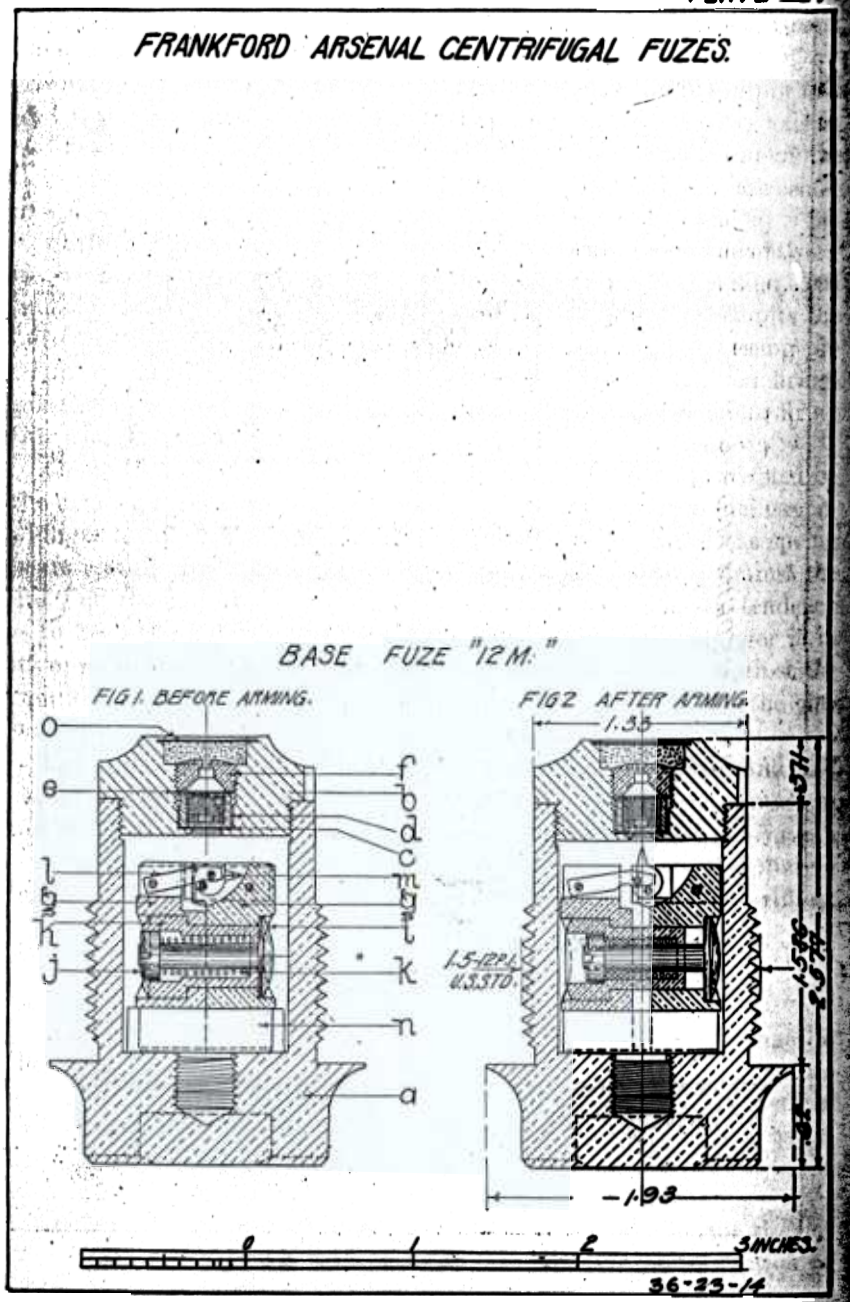
PLATE X.

FRANKFORD ARSENAL CENTRIFUGAL FUZES.



Base Percussion Fuze, Medium and Major Caliber, Present Type (Plate IX).

This fuze differs from the former type in the following respects: A Semple centrifugal plunger is used in place of the F. A. centrifugal plunger, and an all-fulminate primer is used in place of the primer used in the former type.

It consists of the following parts:

a, body, brass.
b, closing-cap screen, brass.
c, primer shield, brass.
d, primer body, brass.
e, primer disk, paper.
f, primer-closing screw, brass.
g, reenforcing charge, loose shrapnel powder.
h, end-closing disk, brass.
j, plunger, brass.
k, plunger housing, brass.
l, firing pin, brass.
m, firing-pin fulcrum.
n, safety pin, brass.
o, safety-pin spring, brass.
p, restraining spring, brass.
q, restraining-spring housing, brass.

The plunger *j* is provided with a slot to receive the firing pin *l*, which is mounted on the fulcrum *m* and kept in the unarmed position by two safety pins *n*, one shown on Plate IX in recesses on opposite sides of the plunger and held in the hole in the firing pin by the tension of the springs *o*. These springs are designed to suit the velocity of rotation of the particular projectile in which the fuze is used. The centrifugal force due to the rotation of the projectile forces the pins outward against the tension of the springs and releases the firing pin, which is rotated by the same centrifugal force into its armed position. The entire plunger and housing is held to the rear by two springs *p*, one shown on Plate IX, pressing on the closing screw through the housing *q*.

Centrifugal Fuze, 12 M (Plate X, figs. 1 and 2)

This fuze is used in torpedo detonating fuzes, Peirce stocks, tapped therefor, to the number of 2,200. (It is probable that these fuzes will be withdrawn and the torpedo detonating fuzes altered to take the Semple centrifugal plunger and be made otherwise similar to the medium caliber base detonating fuze.)

COMBINATION FUZES.

All combination fuzes used in the service are point insertion and combine the elements of time and percussion arranged to act independently in one fuze body.

Combination fuzes contain two plungers and two primers, arming and firing by concussion and percussion respectively.

The concussion plunger arms and fires the concussion primer by shock of discharge in the bore of the piece and ignites the time element. The percussion plunger is armed by the shock of discharge and fires its primer on impact.

There are at present two general classes of combination fuzes in service, differing principally in the details of the time-train elements. In the first class this element consists of a wire-drawn lead tube filled with meal powder wound in a spiral groove around a lead cone. In the second class this element consists of two superposed trains of meal powder compressed under heavy pressure into annular grooves in disks of brass.

The first class is represented by the following Frankford Arsenal combination fuzes, of which there are a considerable number on hand: the 15-second, the 28-second high-resistance, and the 28-second low-resistance combination fuzes. No more fuzes of this class are to be manufactured.

Combination fuzes belonging to the first class can not be reset, while those belonging to the second class may be reset as many times as may be desired.

The second class is represented by the Frankford Arsenal 21-second combination fuze. The method of preparing the time train of this fuze insures much greater uniformity in the action of the fuze than in the case of the lead-train fuze. It has, therefore, been adopted for use.

The Ehrhardt and the Krupp combination fuzes, of which there are a limited number at present in service, belong to the second class. They differ from the Frankford Arsenal 21-second combination fuze and from each other principally in the details of the plunger and primer elements, as is indicated in the description and the drawings.

All fuzes belonging to the second class, Frankford Arsenal combination fuze, Krupp combination fuze, and Ehrhardt combination fuze, are provided with a stud fitting in the movable time-train disk, and a slot in the fuze body to enable them to be set for a given range by means of a fuze setter.

The 15-Second Combination Fuze (Plate XI, figs. 1 to 5).

This fuze consists of the following parts, assembled as shown on the drawing:

- *a*, body, bronze.
- *b*, powder ring.
- *b'*, retaining ring, brass.
- b^2, brass washer.
- b^3, gas-check cup.
- b^4, felt washer.
- *c*, time train.
- *d*, time-train cone, lead.
- *e*, cone cover, brass.
- *f*, cap, brass.
- *g*, clamping nut, brass.
- *h*, concussion or time plunger, brass.
- *h'*, time-plunger safety ring, brass.
- *i*, safety pin, copper wire.
- *j*, connecting tube.
- *k*, closing screw, brass.
- *k'*, powder magazine.
- *l*, percussion primer.
- *m*, concussion firing pin, steel.
- *n*, percussion plunger sleeve, brass.
- *o*, percussion plunger, brass.
- *p*, cone dowel pins, brass.
- *q*, cover dowel pins, brass.
- *r*, percussion composition.
- *r'*, tin-foil disk.
- *s*, vents (4).
- *t*, percussion-plunger safety ring, brass.
- *u*, wrench hole.
- *z*, bottom closing screw, brass.
- *z'*, paper disk.
- z^2, base cover, brass.

The time element is composed of the concussion or time plunger *h*, the firing pin *m*, the cone *d*, the time train *c*, the cone cover *e*, the cap *f*, and the clamping nut *g*.

The plunger *h* is cylindrical in shape and contains the fulminate primer *r* in a recess at its base. Its upper extremity is pierced to receive a safety pin, *i*, which retains the plunger in its safe or unarmed position in handling and transportation. When the safety pin is removed, which is done just before firing, the weight of the plunger rests on the time-plunger safety ring *h'*.

The action of the latter on discharge is similar to that of the arming resistance ring of other ring-resistance fuzes already described.

The cone *d* is an alloy of soft metal held in place on the fuze body by the clamping nut *g* and a groove at the bottom, and is prevented from turning by four steel dowel pins, *p*.

The lip on the bottom of the cone, entering the groove in the body, acts as a gas check to prevent ignition of the powder in the connecting tube. On the exterior of the cone *d* is a left-handed groove which carries the time train *c*, and this time train communicates at its lower end with the priming charge in the tube *j* and thence with the magazine *k'*.

The time train *c* is formed of a lead tube filled with meal powder and wire drawn.

The cone cover *e* is of brass, and is held in place by the cap *f*, and prevented from turning by a small pin *q*, projecting from the body *a*, and fitting in a slot in its lower edge. On the exterior of the cone is a left-handed groove corresponding to that on the time cone *d*, and this groove is pierced with holes numbered from 1 to 15, corresponding to the number of seconds, the spaces between the holes being divided into five equal parts.

The percussion element of this fuze consists of a ring-resistance plunger and an ordinary percussion primer.

ACTION OF THE FUZE.

As a Time Fuze.—A hole is punched through the cover, time train, and lead cone at the point in the cover corresponding to the number of seconds desired. Just before loading, the safety pin *i* is removed. This allows the time plunger *h* to rest on the fuze body, where it is held by the safety ring *h'*. The projectile is now inserted in the gun. By shock of discharge the safety ring is expanded and the plunger forced to the rear, the primer *r* striking the firing pin and exploding. The flame from the primer passes through the four radial holes *s* and ignites the ring of compressed powder *b*. The only vent for these gases is the punched hole, and they ignite the time train at that point. The latter burns and ignites the powder in the tube *j* and the magazine *k*. The flame from the magazine charge passes through the percussion primer and percussion-plunger chamber and ignites the bursting charge in the shrapnel.

As a Percussion Fuze.—The percussion plunger arms by shock of discharge and fires the percussion primer on impact as in other percussion fuzes. The percussion plunger is grooved or fluted to permit ready passage of the flame from the front to the rear. In order to use this fuze in base-charge shrapnel an extension piece of

PLATE XI.

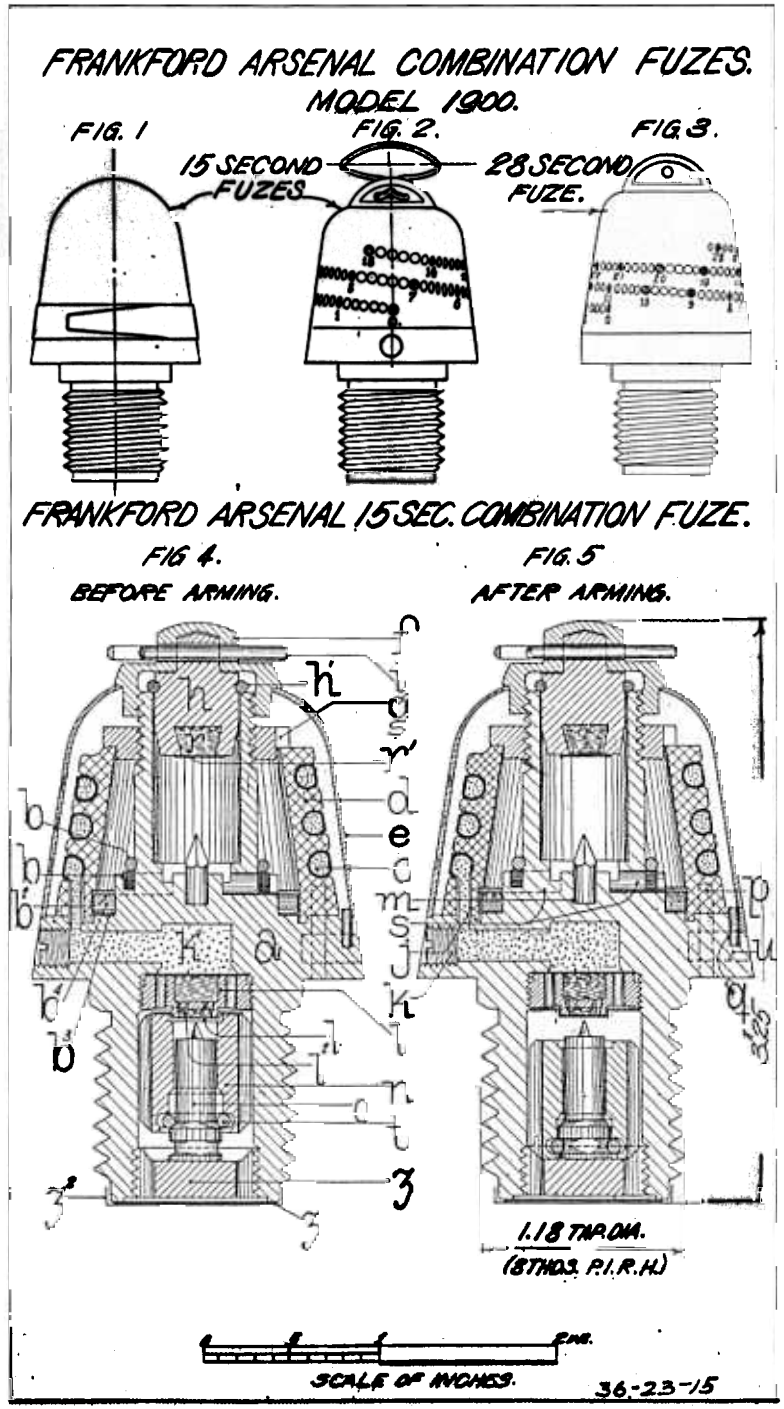
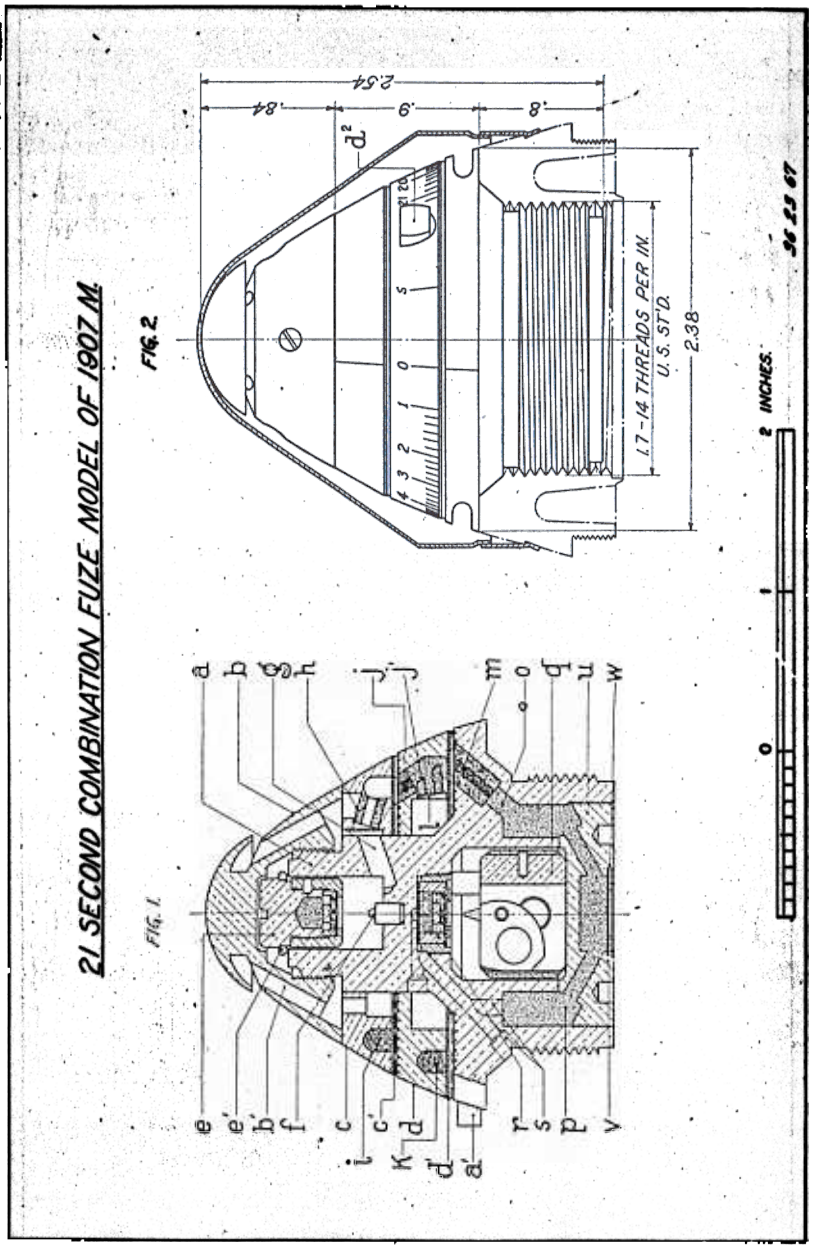


PLATE XII

21 SECOND COMBINATION FUZE MODEL OF 1907 M.



the form shown on the drawing is screwed into the base of the fuze in place of the bottom closing screw *z*. The ignition of the pellet of compressed powder in the extension piece transmits the flame through the central tube to the base charge.

The 28-Second Combination Fuze, High and Low Resistance.

These fuzes do not differ essentially from the 15-second combination fuze except that the low-resistance fuze is provided with a wire passing through the walls of the fuze and the percussion plunger to prevent the latter from arming prematurely in transportation or handling. An outside view of this fuze is shown on Plate VIII, fig. 3.

Frankford Arsenal 21-Second Combination Fuze, Model of 1907 M (Plate XII).

The fuze consists of the following parts, assembled as shown in the drawing:

a, body, bronze.
a', stop pin, brass.
b, closing cap, brass.
b', vents in closing cap.
c, upper time-train ring, Tobin bronze.
c', washer for time-train ring, graduated, felt cloth.
d, time-train ring, graduated, Tobin bronze.
d', washer for body, felt cloth.
d², rotating pin, brass.
e, concussion plunger.
e', concussion resistance ring, brass.
f, firing pin, brass.
g, vent leading to upper time train.
h, compressed powder pellet.
i, upper time train, compressed powder.
j, compressed powder pellet, in vent leading to lower time train.
j', compressed powder pellet in lower time-train vent.
k, lower time train, compressed powder.
l, brass disk, crimped in place.
m, compressed powder pellet in vent *o*.
o, vent leading to magazine.
p, powder magazine.
q, percussion plunger.
r, percussion primer.
s, vents leading from percussion primer to magazine.
u, bottom closing screw, brass.
v, washer for closing screw, muslin.
w, washer for closing screw, brass.

The body *a* of this fuze is machined from a bronze casting. The time-train rings *c* and *d* are turned from hard-rolled rods of Tobin bronze. An annular groove in the shape of a horseshoe is milled in the lower face of each of the time-train rings. Meal powder is compressed into these grooves under a pressure of 66,000 pounds per square inch, forming a time train, the total length of which is 9 inches.

The time element of this fuze is composed principally of the following parts: The time or concussion plunger *e*, the concussion resistance ring *e'*, the firing pin *f*, the vent *g* leading to the upper time train, the compressed powder pellet *h*, the upper time train *i*, the vent *j*, the lower time train *k*, the compressed powder pellet *m* in the vent *o*, leading to the powder magazine *p*.

The plunger *e* is cylindrical in shape and contains the percussion composition in a recess at its base. The weight of the plunger rests upon the concussion resistance ring *e'*, which keeps the primer from contact with the firing pin. At discharge of the gun the resistance of the ring is overcome and the primer is exploded by contact with the firing pin.

As stated above, the annular grooves into which the meal powder of the time train is pressed are in the shape of a horseshoe, a solid portion being left between the ends of the groove in each ring or disk.

The upper time train ring *c* is prevented from rotating by pins which are halved into the fuze body and the inner circumference of the ring.

The vent *g* is drilled through the walls of the concussion plunger chamber and is exactly opposite a hole in the inner surface of the upper time train leading to the end of the train from which the direction of burning is anticlockwise.

The hole *j* is drilled through the upper face of the lower time-train ring *d* to the end of the lower time-train groove, from which the direction of burning is clockwise. The lower time-train ring is movable and is graduated on its outer edge in a clockwise direction from 0 to 21.2, each full division corresponding to 1 second time of burning in flight; these divisions are subdivided into 5 equal parts corresponding to one-fifth second. A radial pin d^2 is provided in the lower ring for engagement with a notch in the fuze setter for setting the fuze. A line on the lower flange of the fuze stock is the datum line for fuze settings.

The vent *o* is drilled through the flange of the fuze stock to the powder magazine *p* and leads to the same end of the lower time train as the vent *j*—that end from which the direction of burning is clockwise—when the fuze is at its "zero" setting.

The action of the fuze as a time fuze is as follows:

Assume first the "zero" setting as shown on the figure. At discharge of the gun the time plunger arms and fires its primer. The flame from the primer passes out through the vent *g*, igniting the pellet *h*, the end of the upper time train *i*, down through the vent *j*, to the end of the lower time train *k*, and thence through the vent *o* to the magazine *p*, the flame from which is transmitted to the base charged in the shrapnel. It will be seen that for the "zero" setting of the fuze the origin of both upper and lower time trains are in juxtaposition. Assume any other setting, say 12 seconds: The vent *j* has now changed its position with respect to the vent *h* leading to the beginning of the upper time train and the vent *o*, leading to the powder magazine *p*, both of which points are fixed by the angle subtended between the 0 and the 12-second settings. The flame now passes out through vent *g* and burns along the upper time train in an anticlockwise direction until the vent *j* is reached, where it passes down to the beginning of the lower time train and burns back in a clockwise direction to the position of the vent *o*, whence it is transmitted by the pellet of compressed powder *m* to the powder magazine *p*.

For the 21.2-second setting the vent *j* leading to the beginning of the lower time train is opposite the end of the upper time train, and the end of the lower time train is opposite the vent *o* leading to the powder magazine. It will now be seen that to reach the magazine *p* and burst the shrapnel the entire length of time train in both rings must be burned.

As already stated, the annular grooves in the lower face of each ring for the powder trains do not form complete circles, a solid portion being left between the ends of the grooves in each. This solid portion is utilized to obtain a setting at which the fuze can not be exploded, known as the "safety point."

This point is marked by a line on the outer edge of the movable time train, surmounted by an "S," and is located about halfway between the zero mark and the 21.2-second graduation. When this point is brought opposite the line on the lower flange of the fuze body, the vent *j* is covered by the solid metal between the ends of the upper train and the vent *o* leading to the powder magazine *p* is covered by the solid metal between the ends of the lower or movable time train.

At the safety setting it will be seen that the upper train may burn entirely out in case of accidental firing of the time plunger, or in case it may be desired to burst the shrapnel by impact or percussion without the flame being able to reach the magazine *p*.

The cloth washers *c'* and *d'* are glued to the upper face of the graduated time-train ring and to the upper face of the flange on the

fuze stock. These surfaces are corrugated, as shown, to make the washers adhere more strongly. The function of the washers is to make a gas check and prevent premature action of the fuzes.

The compressed pellet *j'* in the vent leading from the outside to the beginning of the lower time train is to release the pressure of the gases due to the burning train. The gases from both time trains escape into the outer air through the annular spaces shown in the illustration and the vents *b'* in the closing cap.

The percussion element of this fuze, as shown in the plate, consists of a percussion plunger *q* and an ordinary percussion primer *n*.

The system of vents through the walls of the fuze shown in fig. 2 conduct the flame from the percussion primer to the magazine *p*.

The bottom closing screw closes the percussion-plunger recess and keeps the powder in the magazine. The muslin washer *v* is coated with shellac and held in place by the brass washer *w*, over the outer edge of which a projecting lip is crimped.

These fuzes are issued assembled in shrapnel. For transportation in limbers and caissons the fuze should always be set at the safety point.

The fuze is provided with a waterproof hood of thin brass, hermetically sealed. The hood should be stripped off before an attempt is made to set the fuze.

The Frankford Arsenal 21-Second Combination Fuze, Former Type (Plate XIII).

This fuze differs essentially from the one just described only in the method of providing for the escape of the gases from the burning time trains.

About 4,000 fuzes have been manufactured in accordance with the form shown in figs. 1 and 2, Plate XIII.

Except the above, all Frankford Arsenal 21-second combination fuzes issued prior to January 1, 1908, have been of the form shown in figs. 3 and 4, Plate XIII. Centrifugal percussion plungers arming at 2,500 revolutions per minute were used in the first 15,000 of these fuzes manufactured. The remainder are provided with ring-resistance plungers.

The 31-Second Combination Fuze, Model of 1907 M (Plate XIV).

This fuze does not differ in principle from the 21-second combination fuze, model of 1907 M.

The 31-second fuze is made larger, so as to provide a time train of greater length, and is provided with a low-resistance concussion plunger which is rendered safe in transportation by means of a safety wire. Two types of low-resisting concussion plungers are used with this fuze. One with an arming ratio of 8 for guns and another with an arming ratio of 10 for howitzers.

PLATE XIII.

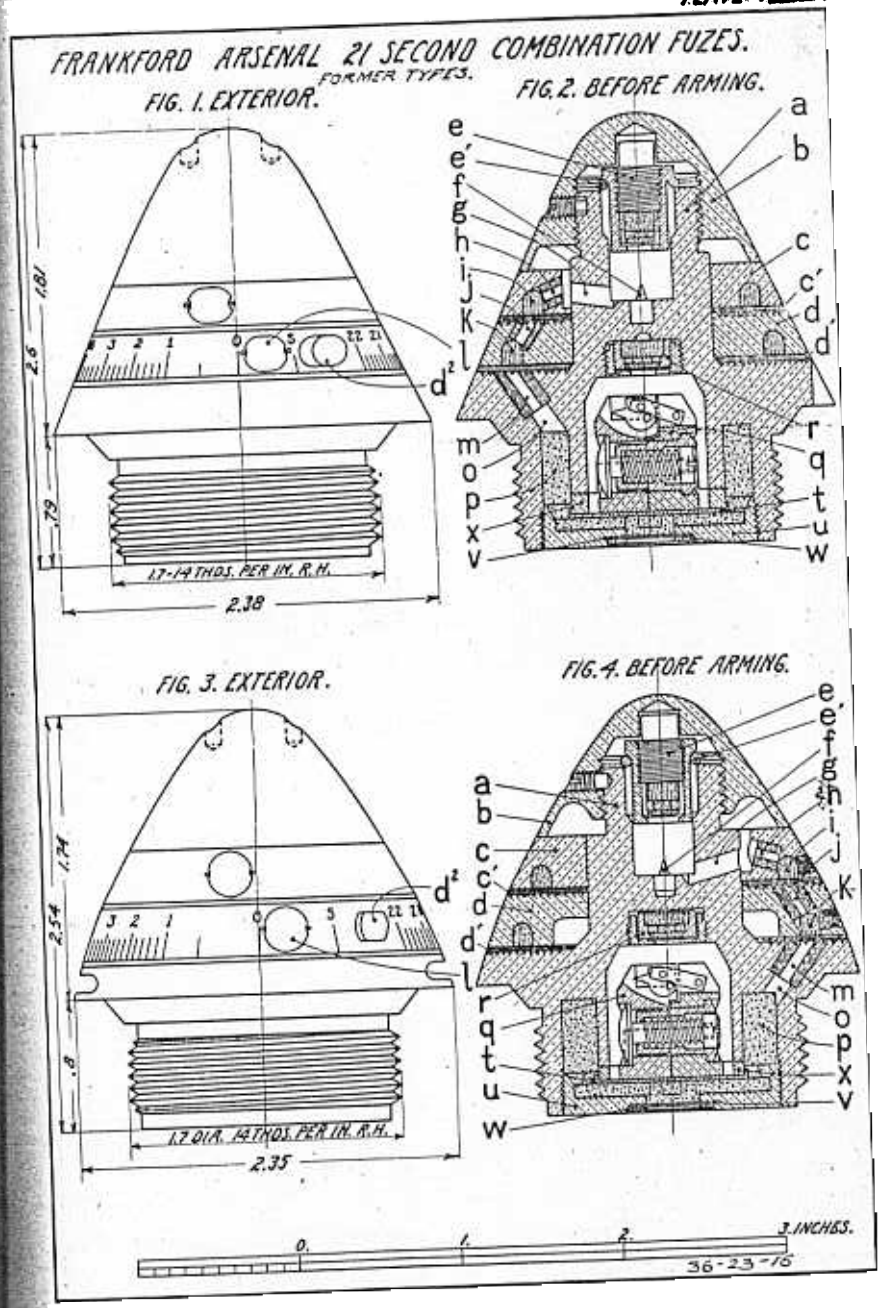


PLATE XIV.

31 SECOND COMBINATION FUZE.

FIG. 1

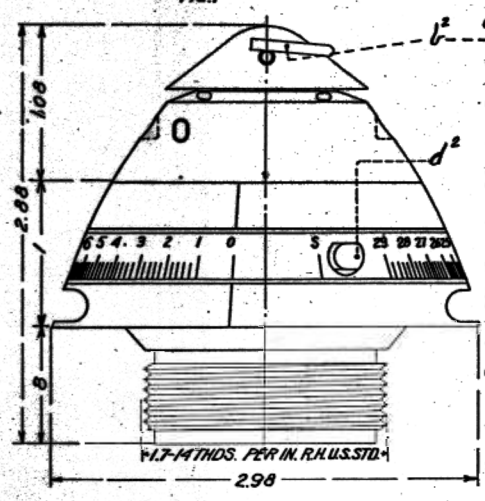
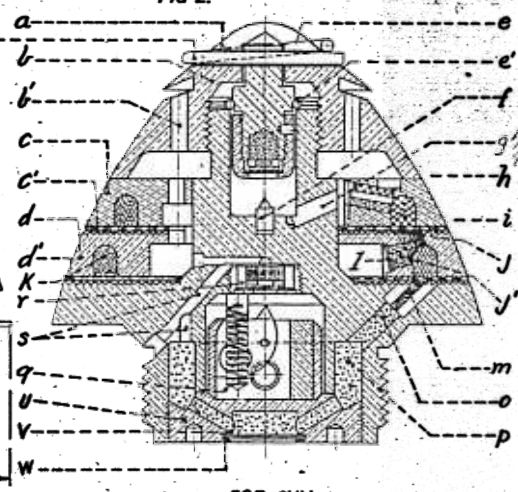


FIG. 2.



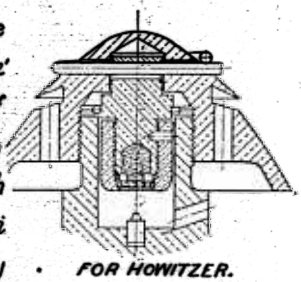


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PLATE XV.

30 SECOND COMBINATION FUZE MODEL OF 1911.

FIG. 1.

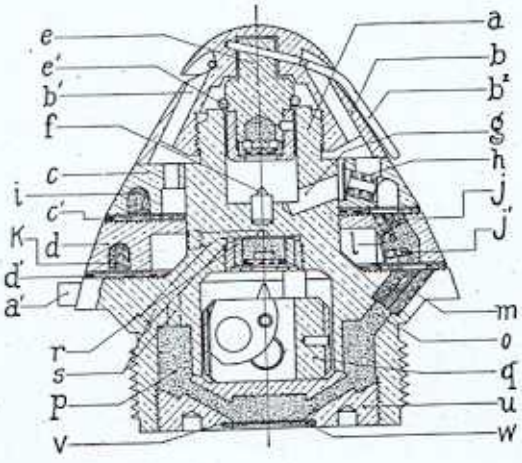
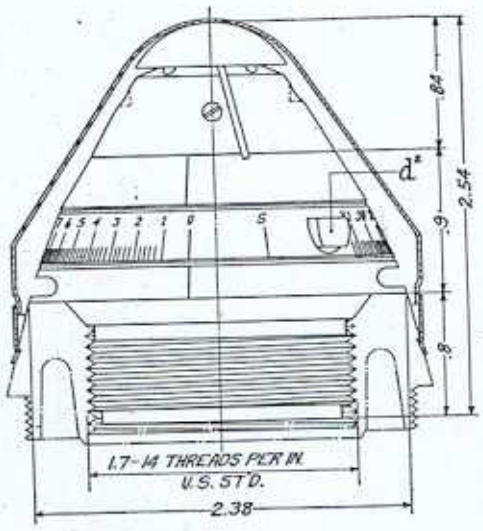


FIG. 2.



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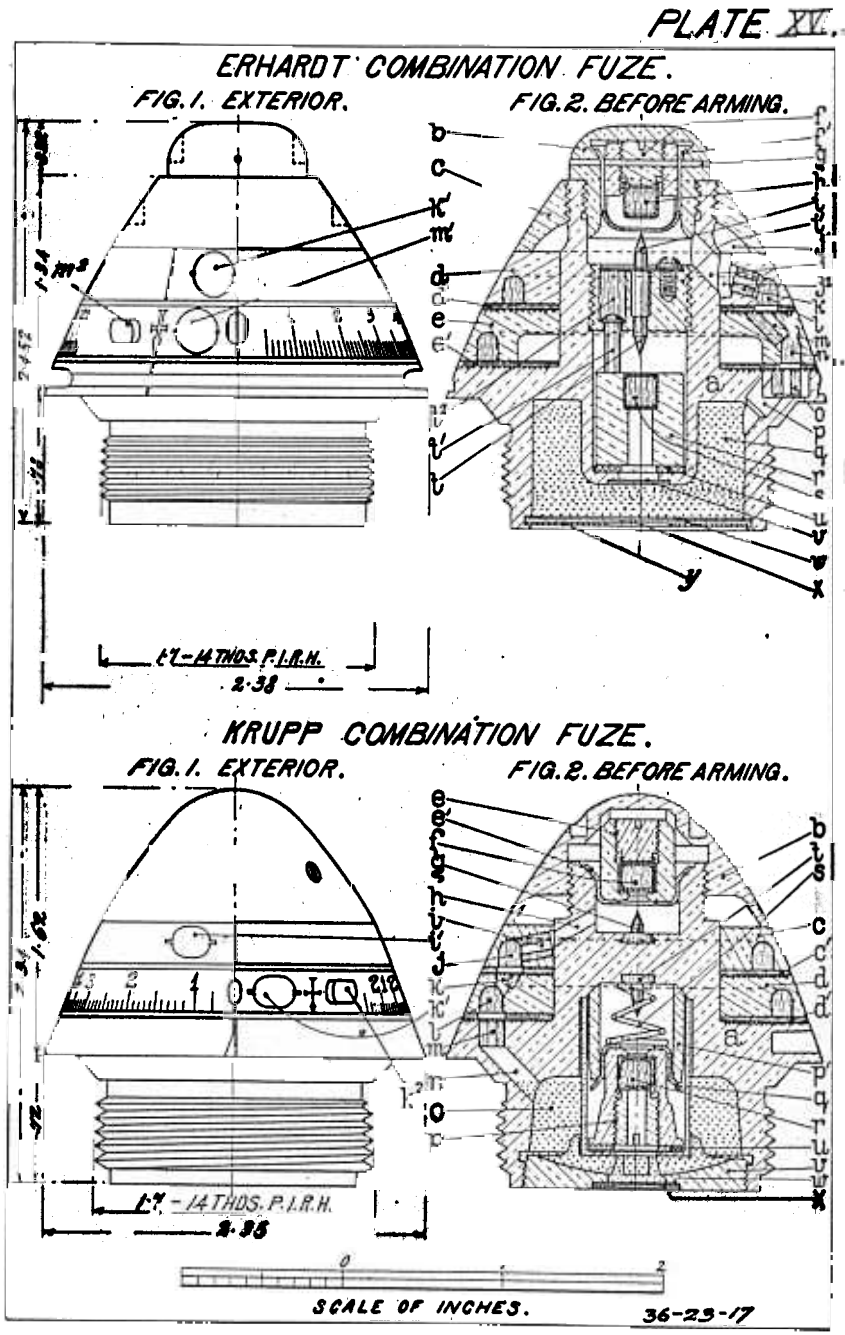


The 30-Second Combination Fuze, Model of 1911 (Plate XV)

This fuze is intended for use in the 3-inch mountain howitzer and is similar to the 21-second fuze, model of 1907M, except the composition of the time train and the graduations of the rings. It is also provided with a safety wire b^2, which passes through a hole in the closing cap, and a projection on the concussion plunger to prevent accidents in handling. This precaution is necessary on account of the low arming resistance of the fuze.

Ehrhardt Combination Fuze (Plate XVI)

This fuze consists of the following parts:

a, body, brass.
b, closing cap screw, brass.
c, closing cap, brass.
d, upper time-train ring, brass.
d', felt washer.
e, lower time-train ring, brass.
e', felt washer.
f, time or concussion plunger.
f', arming resistance spring, brass.
g, arming resistance pin, copper.
h, fulminate primer.
i, concussion firing pin, German silver.
i', firing-pin screw, brass.
j, channel leading to upper time train.
j', vent leading to expansion chamber j^2.
j^2, expansion chamber.
k, compressed-powder pellet in vent leading to expansion chamber.
k', vent for upper time train.
l, upper time train, compressed powder.
m, powder pellet in hole leading to lower time train.
m', vent for lower time train.
m^2, rotating pin, brass.
n, lower time train, compressed powder.
o, pellet compressed powder in channel leading to powder magazine.
p, channel to powder magazine.
q, powder magazine.
r, percussion plunger, brass.
s, percussion primer.
t, percussion firing pin, German silver.
t', safety stop pin, brass.
t^2, restraining pellet, compressed powder.

u, lead washer.
v, linen gauze.
w, linen disk.
x, linen disk.
y, bottom closing screw, brass.

This fuze was manufactured in Germany by the Rheinische Metallwaaren und Maschinenfabrik.

All metal parts are of brass or German silver.

An examination of the drawing will show that the time element consists of the time plunger and a system of channels similar to those used in the Frankford Arsenal 21-second fuze.

The arming of the time plunger *f* is resisted by the U-shaped spring *f'*, the upper ends of which are sprung out into the counterbored recess in the closing cap screw and by the copper pin *g*, which passes through the plunger and both sides of the closing cap screw.

The concussion primer *h* is a fulminate of mercury mixture inclosed in a copper case, which is dropped into the concussion plunger from the rear, and held in place by the closing screw shown on the drawing.

The firing pin *i* is of German silver in one piece with the percussion firing pin; it is made fast in the firing-pin screw *i'* by means of a shoulder bearing below and a plate screwed to the firing-pin screw above.

The time-train grooves in the upper and lower rings *d* and *e* are milled out in the form of a horseshoe, as in the case of the Frankford Arsenal 21-second fuze.

The channel *j*, from the time plunger recess to upper time train, leads in this fuze to that end of the train from which the direction of burning is clockwise; and the channel from the upper to the lower time train leads to that end of the latter from which the direction of burning is anticlockwise. It will thus be seen that the direction of burning in the Ehrhardt fuze is the reverse of that in the Frankford Arsenal fuze.

The lower time-train ring is graduated in an anticlockwise direction from 0 to 22 seconds. The setting is made to a datum line cut in the lower flange of the fuze.

The safety point is marked by an arrow and is located about halfway between the 0 and 22-second graduations on the outer edge of the lower time-train ring.

The upper and lower time-train vents *k'* and *m'*, covered by thin brass disks crimped in place, are for the purpose of relieving the pressure of the gases due to the burning of the powder trains.

The inside of the closing cap *c* is bored out to form an expansion chamber, *j'*, into which the gases may expand through the vent j^2.

The percussion element consists of the percussion plunger *r*, the percussion primer *s*, the firing pin *t*, the safety stop pin *t'*, the restraining pellet of black powder t^2, and the magazine charge *q*.

The restraining pin *t'* is of brass, and has a head at the upper end. It is let into a hole in the firing pin screw *i'*, the head abutting against a shoulder near the bottom of the hole. The restraining pellet of powder t^2 is pressed in to fill the recess above the restraining pin. A brass disk prevents the pellet from jarring out of place.

The restraining pin holds the percussion plunger back and prevents premature firing of the percussion primer *s* in handling or transportation. The percussion primer is a mercuric fulminate mixture and is inclosed in a copper case which is let into the front end of the percussion plunger and retained there by crimping over a portion of the metal of the plunger. The plunger is drilled centrally, the hole coming opposite a vent through the bottom of the percussion plunger cavity leading to the magazine *q*. This hole is close by a disk of gauze heavily coated with shellac.

The action of the percussion element is as follows: The firing of the time or concussion primer by shock of discharge ignites the restraining pellet t^2 at the front end, quickly burning it out, after which the safety stop pin is free to move to the front. On impact, the firing pin *t* fires the percussion primer which ignites the magazine charge *q*.

The rear end of the fuze is closed by means of the linen washers *w* and *x* and the bottom closing screw *y*.

IMPORTANT.

When shrapnel fitted with Ehrhardt fuzes are fired for impact action, against walls or other objects where delay action is desired on impact, the fuzes should be set at V (opposite the graduation on the rotating pin). When fired for nondelay action on impact, the fuzes should be set at "safe."

Krupp Combination Fuze (Plate XI).

This fuze consists of the following parts:

a, fuze body, brass.
b, front closing cap, brass.
c, upper time-train ring, brass.
c', cloth washer.
d, lower time-train ring, brass.
d' cloth washer.
e, time concussion plunger.
e', concussion plunger spring cup, brass.
f, concussion primer.
g, concussion firing pin, German silver.
h, channel leading to upper time train.

i, compressed powder pellet.
j, upper time train, compressed powder.
k, pellet in vent to lower time train.
*k*², rotating pin, brass.
l, lower time train, compressed powder.
m, pellet in hole to magazine *o*.
o, powder magazine, 125 grains powder.
p, percussion plunger, brass.
p', percussion-plunger sleeve, brass.
q, percussion-plunger spring cup, brass.
r, percussion primer.
s, percussion-plunger resistance spring, brass.
t, percussion firing pin, German silver.
u, lead washer.
v, bottom closing screw, brass.
w, linen gauze.
x, brass washer.

An inspection of the drawing will show that this fuze does not differ essentially from the Ehrhardt so far as the time element is concerned. In this case the arming resistance spring *e'* is made strong enough not to require a shear pin, as in the case of the Ehrhardt fuze.

The channels leading to the time trains are arranged, as in the case of Frankford Arsenal 21-second combination fuze, so that the direction of burning in the upper time train is anticlockwise and that in the lower time train clockwise.

The graduations on the outer edge of the lower time train are in a clockwise direction from 0 to 22, decreasing in length. They represent time of burning in flight. The safety point is located in the same manner as for the Ehrhardt and Frankford Arsenal fuzes. The settings are made to an arrow on the lower flange of the fuze body. A pin is fitted in the outer edge of the lower time-train ring to serve as a means for setting the fuze.

The percussion element of this fuze consists of the following parts: The percussion plunger *p* with closing screw, the U-shaped arming resistance spring *q*, the percussion primer *r*, the resistance spring *s*, the percussion-plunger sleeve *p'*, and the firing pin *t*. It will be seen that this plunger resembles in principle the ring-resistance plunger of Frankford Arsenal design. On discharge the percussion-plunger sleeve moves to the rear, coming to a bearing on the flange at the rear of the plunger, arming the plunger and exposing the primer *r* to the blow of the firing pin on impact.

The plunger is drilled centrally, as shown, to allow the flame to pass through and ignite the magazine charge *o*.

The restraining spring *s* is to keep the plunger from creeping forward as the projectile meets with atmospheric retardation in flight.

PLATE XVII.

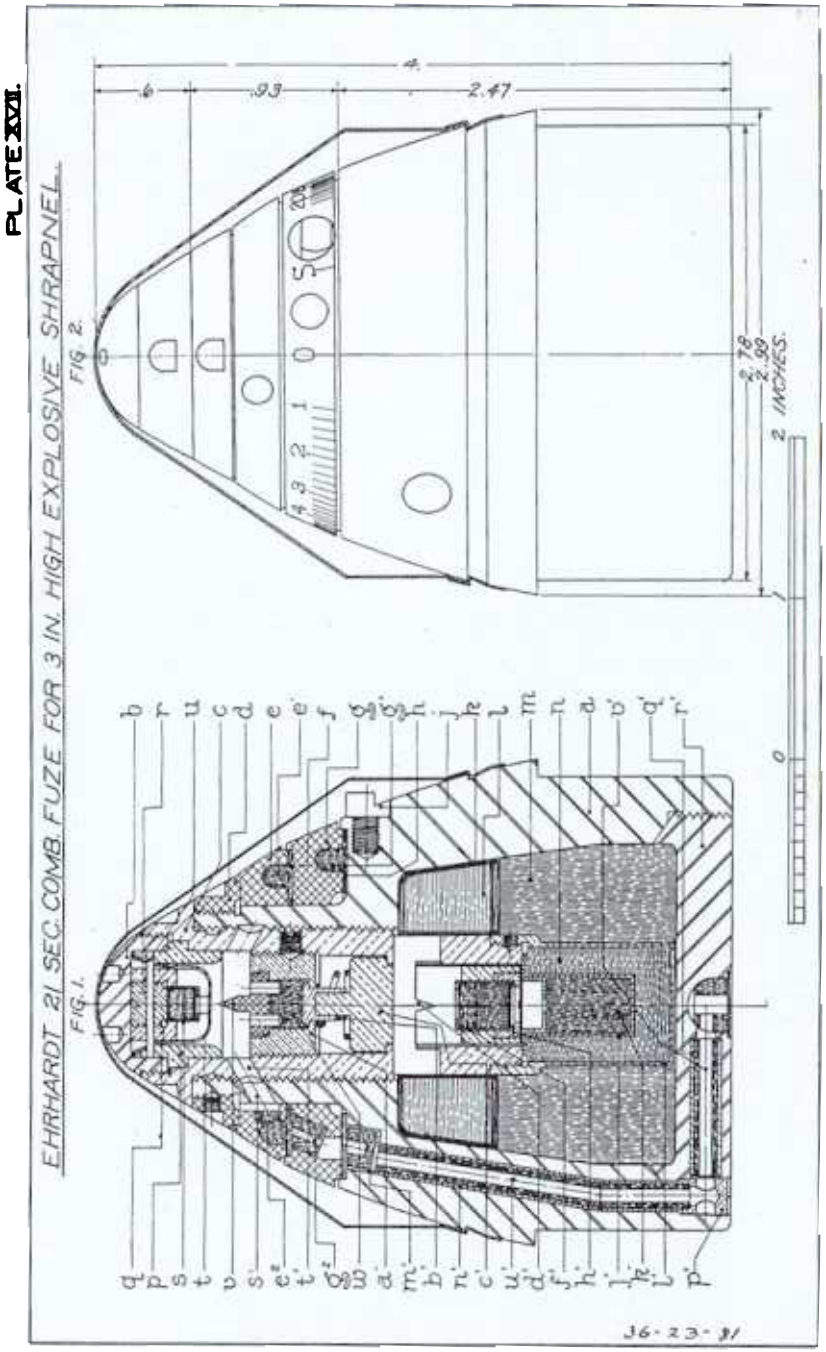
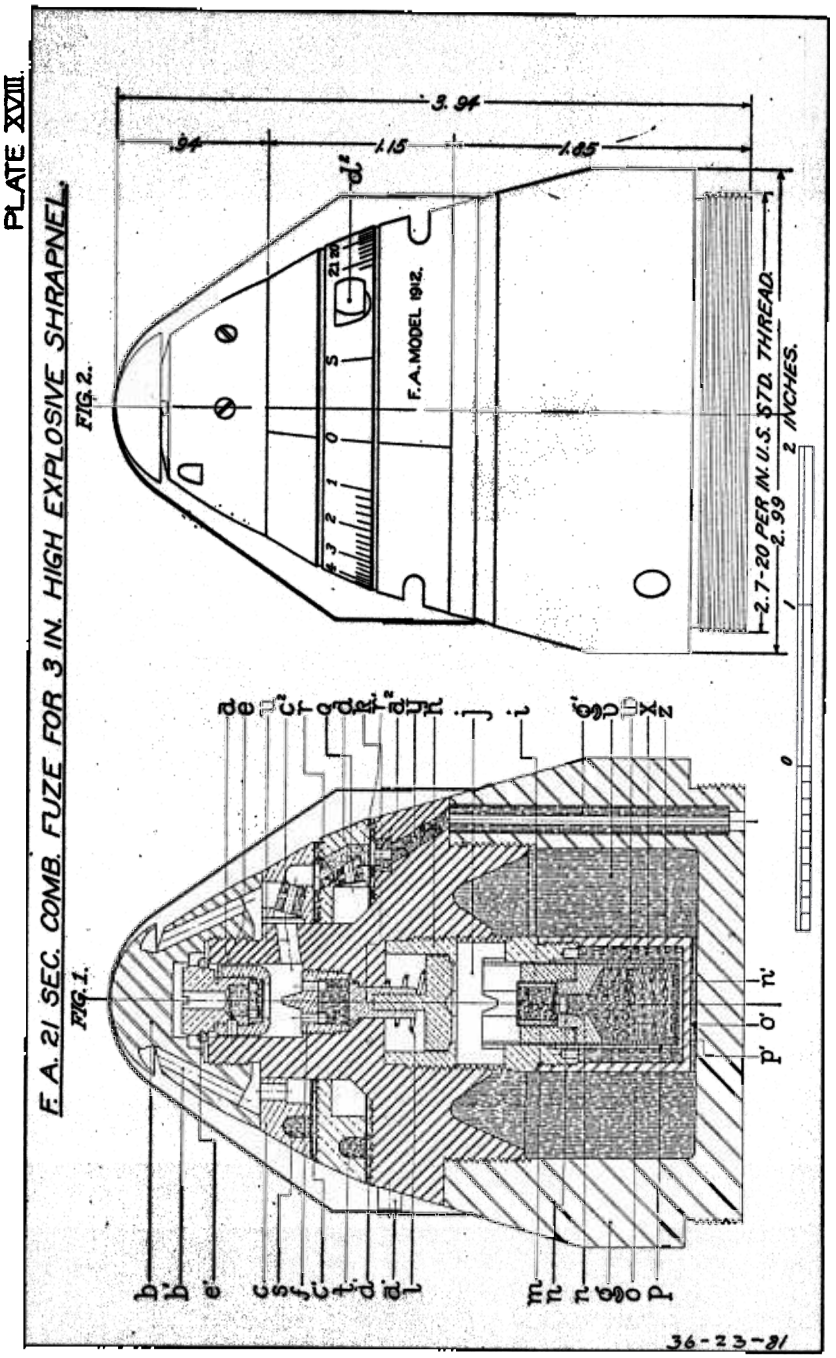


PLATE XVIII.



Ehrhardt 20.4-Second Combination Fuze for 3-inch High Explosive Shrapnel (Plate XVII).

This fuze consists of the following parts, assembled as shown on the plate:

a, high-explosive head, steel.
b, closing cap, steel.
c, plunger sleeve, brass.
d, locking ring, aluminum.
e, upper time-train ring, aluminum.
f, washer for upper time-train ring, felt.
g, graduated time-train ring, aluminum.
h, washer for graduated time-train ring, aluminum.
j, fixed stop pin, steel.
k, smoke-developer hood, pasteboard.
l, smoke developer.
m, picric-acid charge (outer).
n, picric-acid charge (inner).
p, concussion-plunger holder, brass.
q, concussion plunger, brass.
r, concussion-plunger closing screw, brass.
s, concussion primer.
t, locking spring, steel.
u, safety wire, copper.
v, concussion firing pin, German silver.
w, safety pellet, compressed powder.
a′, filling plug, brass.
b′, percussion-plunger cap, brass.
c′, percussion plunger, brass.
d′, percussion firing pin, nickel.
e′, upper time train, compressed powder.
f′, percussion primer.
g′, lower time train, compressed powder.
h′, percussion-plunger closing screw, brass.
j′, detonator cup, copper.
k′, fulminate.
l′, capsule, brass.
m′, flame-channel shoulder bushing, brass.
n′, flame-channel bushing (upper), brass.
p′, flame-channel bushing (lower), brass.
q′, bottom closing-screw flame-channel bushing, brass.
r′, bottom closing screw, steel.
s′, *t′*, vents successively leading to upper time ring.
u′, flame channel in high-explosive head.
v′, flame channel in bottom closing screw.

e^2, compressed-powder pellet in upper time-train vent
g^2, lower time-train vent.

The time element of this fuze is composed principally of the following parts:

The time or concussion plunger q, the locking spring t, the safety wire u, the concussion firing pin v, the vents s' and t' leading to upper time-train ring, the compressed-powder pellet e^2, the upper time train e', the compressed-powder pellet g^2, the lower time train g', leading to the flame channel in the high-explosive head, thence through the central tube to the base charge.

The concussion plunger q is cylindrical in shape, slotted and rounded at the bottom to fit the locking spring. The former contains the primer in a recess at its base. The weight of the plunger rests upon the locking spring and the safety wire u, which keeps the primer from contact with the firing pin. At discharge of the gun, the resistance of the locking spring is overcome, the safety wire is sheared off, and primer is exploded by contact with the firing pin.

An annular groove in the shape of a horseshoe is milled in the lower face of each of the time-train rings, leaving a solid portion between the ends of the groove in each ring. Meal powder is compressed into these grooves, forming a time train, the total length of which is 9 inches.

The vents t' consists of six holes drilled equal distance from each other, connected with each other by a semicircular slot turned on the outside diameter of the plunger sleeve. The vent hole s' is drilled through the walls of the high explosive head and is exactly opposite a hole in the inner surface of the upper time train leading to the end of the train, from which the direction of burning is anticlockwise.

The hole g^2 is drilled through the upper face of the lower time-train ring g to the end of the lower time train, from which the direction of burning is clockwise. The lower time-train ring is movable and is graduated on its outer edge in a clockwise direction from 0 to 22. Each full division corresponding to 1 second time of burning in flight; these divisions are subdivided into five equal parts corresponding to one-fifth second. A radial pin is provided in the lower ring for engagement with a notch in the fuze setter for setting the fuze. A line on the flange of the high explosive head is the datum line for fuze setting.

The action of the fuze as a time fuze is as follows:

Assume the "zero," setting as shown on the figure. At discharge of the gun the time plunger arms and fires its primer. The flame from the primer passes out through the vents t' and s', igniting the pellet e^2, the end of the upper time train e, down through the vent g^2 to the end of the lower time train g, and thence through the channels u' and v' and the central tube to the base charge in the shrapnel

On time burst the head is forced out and continues its flight while the balls are scattered. On impact the percussion plunger e', which is now free (the safety pellet w which holds it having been burned up by the firing of the concussion primer s on discharge of the gun), is thrown forward, coming in contact with the percussion firing pin g', this igniting the percussion primer f'. The flame ignites the fulminate k', this in turn detonating the inner picric acid charge n and the outer picric acid charge m, thus bursting the head.

It will be seen that for the "zero" setting of the fuze the origin of both the upper and lower time train are in juxtaposition.

Assume any other setting, say 12 seconds, the vent g^2 has now changed its position with respect to the vent e^2 leading to the beginning of the upper time train and the channel u' leading to the base charge, both of which points are fixed by the angle subtended between the 0 and 12 second settings. The flame now passes out through the vents t' and s' and burns along the upper time train in anticlockwise direction until the vent g^2 is reached, where it passes down to the beginning of the lower time train and burns back in a clockwise direction to the position of the channel u', whence it is transmitted to the channel v' and central tube.

For the 22-second setting the vent g^2, leading to the beginning of the lower time-train ring, is opposite the end of the upper time train and the end of the lower time train is opposite the channel u', leading to the base charge. It will now be seen that to reach the base charge and burst the shrapnel the entire length of time train in both rings must be burned.

As already stated, the annular groove in the lower face of each ring for the powder trains do not form complete circles, a solid portion being left between the ends of the grooves in each. This solid portion is utilized to obtain a setting at which the fuze can not be exploded, known as the safety point.

This point is marked by a line on the outer edge of the movable time train, surmounted by an "S" and is located about halfway between the zero mark and the 22-second graduation. When this point is brought opposite the line on the flange of the high explosive head, the vent g^2 is covered by the solid metal between the ends of the upper train and the channel u' leading to the base charge is covered by the solid metal between the ends of the lower or movable time train.

At the safety setting it may be seen that the upper train may burn entirely out in case of accidental firing of the time plunger or in case it may be desired to burst the shrapnel by impact or percussion without the flame being able to reach the base charge.

The felt washers *f* and *h* are glued to the upper face of the graduated time-train ring and to the upper face of the flange on the high explosive head. These surfaces are corrugated, as shown, to make the washers adhere more strongly. The function of the washers is to make a gas check and prevent premature action of the fuze.

To release the pressure of the gases due to the burning train a vent hole is drilled into the upper and lower time-train ring leading from the end of the train to the outside. These holes are sealed by aluminum disks, but the pressure due to the burning trains immediately opens them.

These fuzes are issued assembled in shrapnel. For transportation in limbers and caissons the fuze should always be set at the safety point.

The fuze is provided with a waterproof hood of thin brass hermetically sealed. The hood must be stripped off before setting the fuze, but should not be moved until the shrapnel is about to be fired.

21-Second Fuze for 3-inch High Explosive Shrapnel, Model of 1912 (Plate XVIII).

This fuze is now being developed at Frankford Arsenal. The time elements are similar to the 21-second fuze, Model of 1907 M, with the exception of the firing pin, which is screwed into place and has a cavity in its rear end to receive the safety pellet of compressed powder to restrain the movement of the percussion plunger. The percussion elements are somewhat similar to those of the 20.4-second Ehrhardt fuze for 3-inch high-explosive shrapnel, modification being made in the arrangement of the detonating charge.

DETONATING FUZES (PLATES XIX, XX, XXI, AND XXII).

The detonating fuzes used in service are enumerated in Table IV. This table gives all the information to be published in connection with fuzes of this class.

Plates XIX, XX, XXI, and XXII show the outlines of these fuzes.

Projectiles pertaining to reserve seacoast ammunition are marked with lot numbers as indicated in the following tables. Reference is made to Ordnance Department Pamphlet No. 1872, Seacoast Artillery Ammunition:

Boxes containing detonating fuzes should be marked by means of metal labels with the same lot numbers as the projectiles to which they are assigned. Metal labels for marking the fuze boxes are to be obtained from Frankford Arsenal and furnished to posts by the armament officers. Coast-defense ordnance officers should see that all

boxes are properly marked, requisitioning on the proper armament officer for any necessary labels not yet supplied. Boxes containing base covers, calking wire, and lead filling pieces should also be similarly marked, except that metal labels are not required.

(*a*) The following table gives the system of lot numbers for projectiles and fuzes in the United States and Isthmian Canal Zone:

Fuze.	Delay or nondelay primer.	Projectile.	Lot No.
Medium and major caliber, base percussion.	Nondelay.	Shell, Armstrong design, cast steel, powder charged.	1
Medium caliber, base detonating	Delay	Shot, Ordnance Department design.	
	Nondelay	Shell, Ordnance Department design.	2
Siege detonating, modified Peirce stock.	....do....	Shell	20
A. P. detonating, modified Peirce stock.	....do....	Torpedo shell, 800-pound	22
	....do....	Torpedo shell, 1,000-pound	5
	Delay	D. P. shell, 1,046-pound	12
	Nondelay	A. P. shell	3
Major caliber, base detonating	Delay	A. P. shot	9
	....do....	D. P. shell, 700-pound	11
	....do....	D. P. shell, 824-pound	13
	....do....	D. P. shell, 1,046-pound	14
	Nondelay	A. P. shell	16
	....do....	Torpedo shell, 800-pound	

(*b*) Philippine and Hawaiian Islands. The following table shows the system of lot numbers adopted for projectiles and fuzes in the insular possessions:

Fuze	Primer.	Projectile	Lot No.
Medium and major caliber, base percussion.	Nondelay	Shell, Armstrong design, cast steel, powder charged.	8
Medium caliber, base detonating	Delay	Shot	1
	Nondelay	Shell	2
	....do....	Shot, Armstrong design	10
	....do....	Shell, Armstrong design, strong head	6
Major caliber, base detonating	Delay	Shot and 824-pound D. P. shell	1
	....do....	D. P. shell, 700-pound	9
	Nondelay	A. P. shell	2
	Delay	D. P. shell, 1,046-pound	2
detonating, modified Peirce stock.	Nondelay	A. P. shell	4
	Delay	D. P. shell, 824-pound	3
	....do....	D. P. shell, 1,046-pound	4

Point Detonating Fuze, Mark I (Russian Type) (Plate XXIII).

The fuze is of the type which has what is known as the detonator safety feature; that is, the detonator is separated from the booster charge and surrounded by an air chamber in such a manner that if the detonator should become ignited prematurely, either in storage or in the bore of the gun, the gases can expand into the safety chamber and not ignite the bursting charge of the shell.

The principal parts of the fuze are the stock (*a*), the striker rod (*b*), upon which is mounted the detonator (*c*). The detonator is located in the safety chamber (*d*) until the striker rod moves forward upon impact of the projectile, at which time it is carried forward so that when the firing pin (*e*) explodes the detonator by a

direct impact with it, the detonator has moved forward so as to be opposite the booster charge (*f*). The striker rod is held in the rearward position during transportation and storage by means of an arming sleeve (*g*) and the stirrup (*h*). When the projectile is accelerated in the gun the sleeve (*g*) sets back over the stirrup (*h*), flattening this stirrup and at the same time bringing it in front of the shoulder (*i*) of the sleeve. The striker rod is now held to the rear only by the restraining spring (*j*), which is compressed as the striker rod goes forward on impact.

The fuze differs from the types previously used in that the firing pin explodes the detonator by direct impact with it, rather than by means of a separate primer.

The fuze is of the ordinary quick-acting type, which is indicated by a letter (*q*) stamped on the head of the fuze stock and by the white paint on the front closing plug.

PLATE XIX

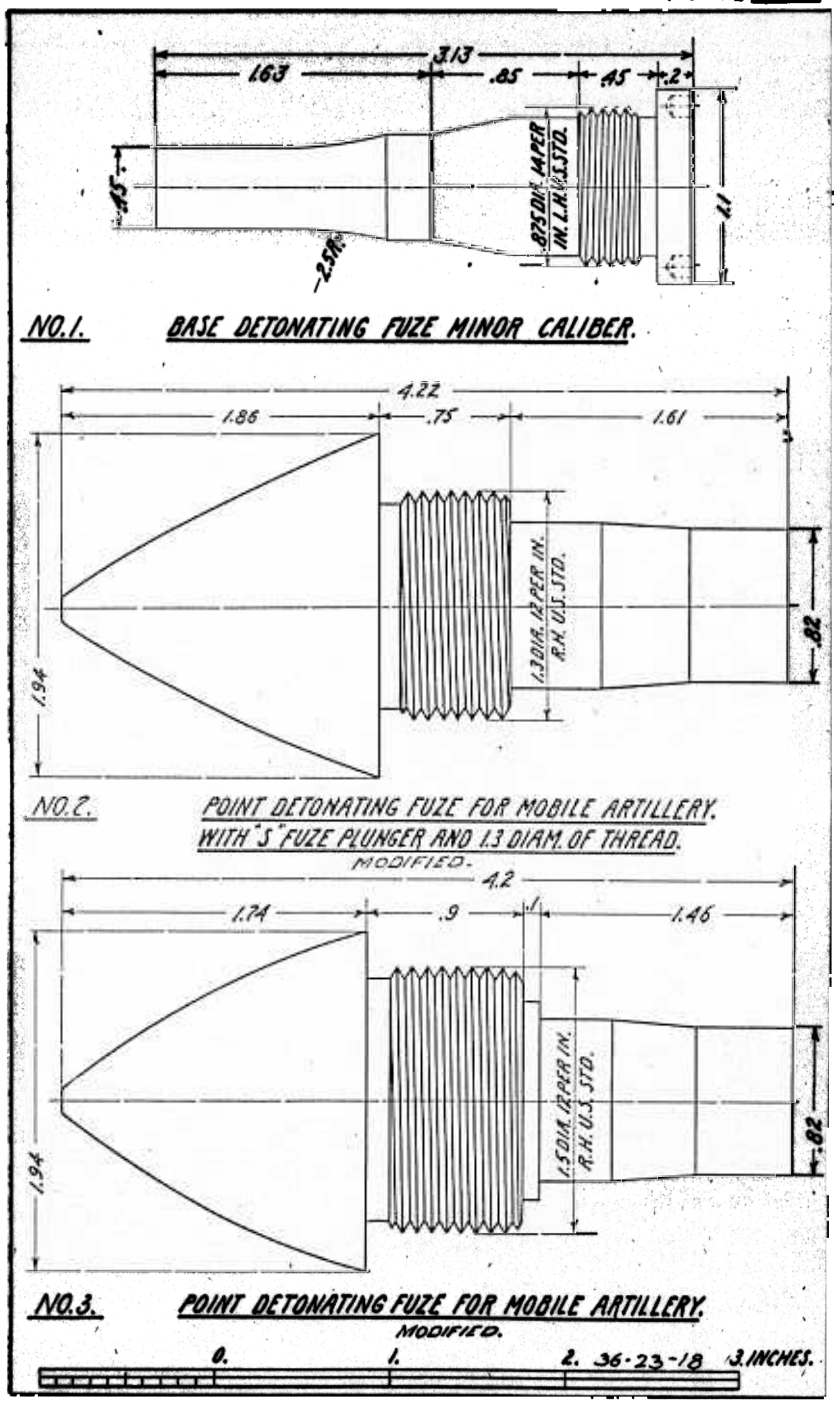
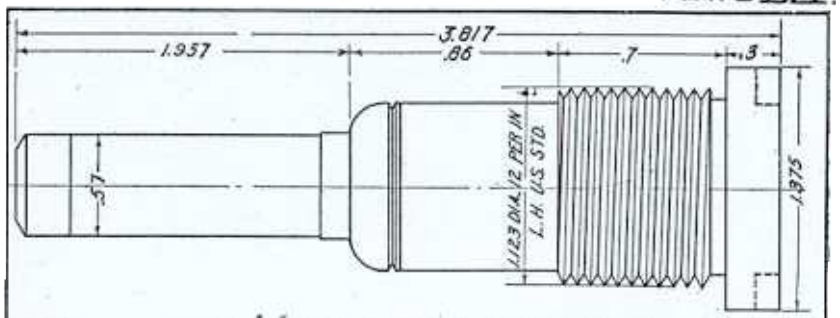
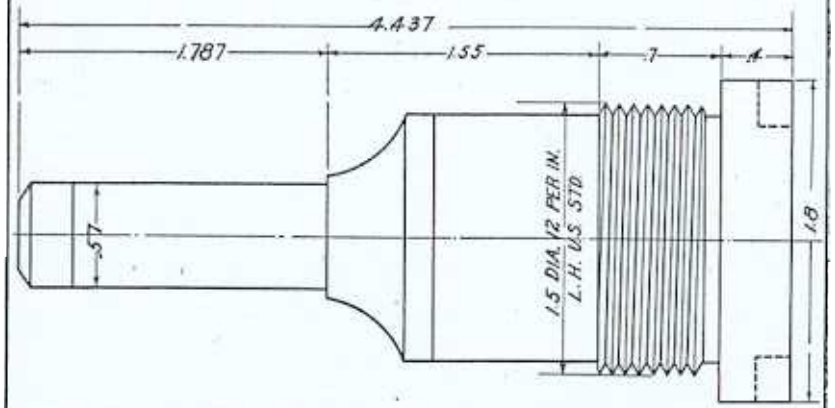


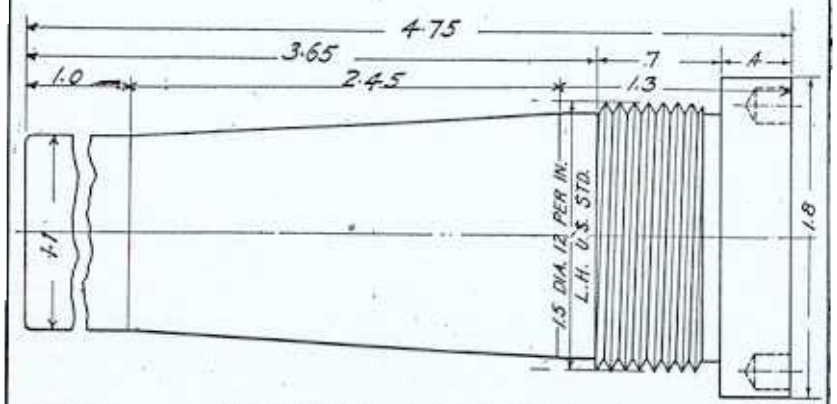
PLATE XX.



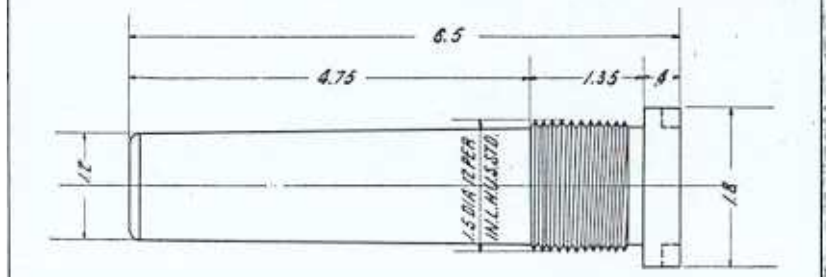
NO.4. SPECIAL "S" FUZE WITH 100 GRAIN DETONATOR.



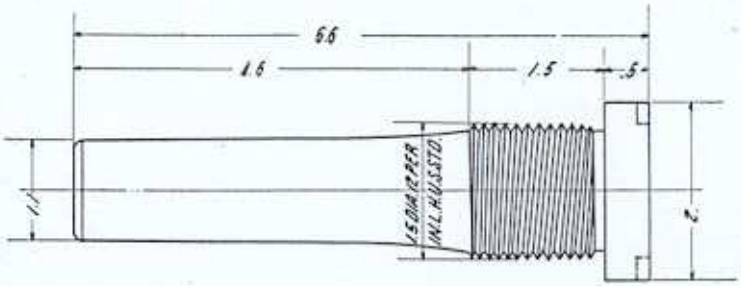
NO.5. BASE DETONATING FUZE FOR MINOR CALIBER PROJECTILES.



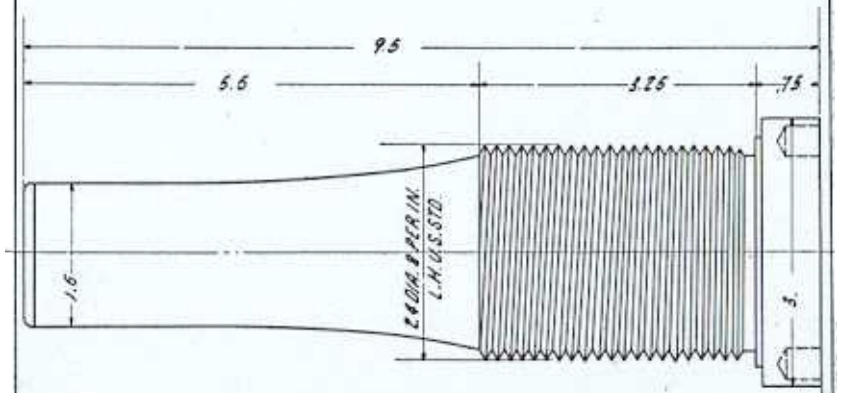
NO.6. BASE DETONATING FUZE MEDIUM CALIBER.



NO.7. BASE DETONATING FUZE FOR MEDIUM CALIBER PROJECTILES.



NO.8. SIEGE DETONATING FUZE MODIFIED PIERCE STOCKS.



NO.9. A.P. DETONATING FUZE MODIFIED PIERCE STOCKS.

PLATE XXII

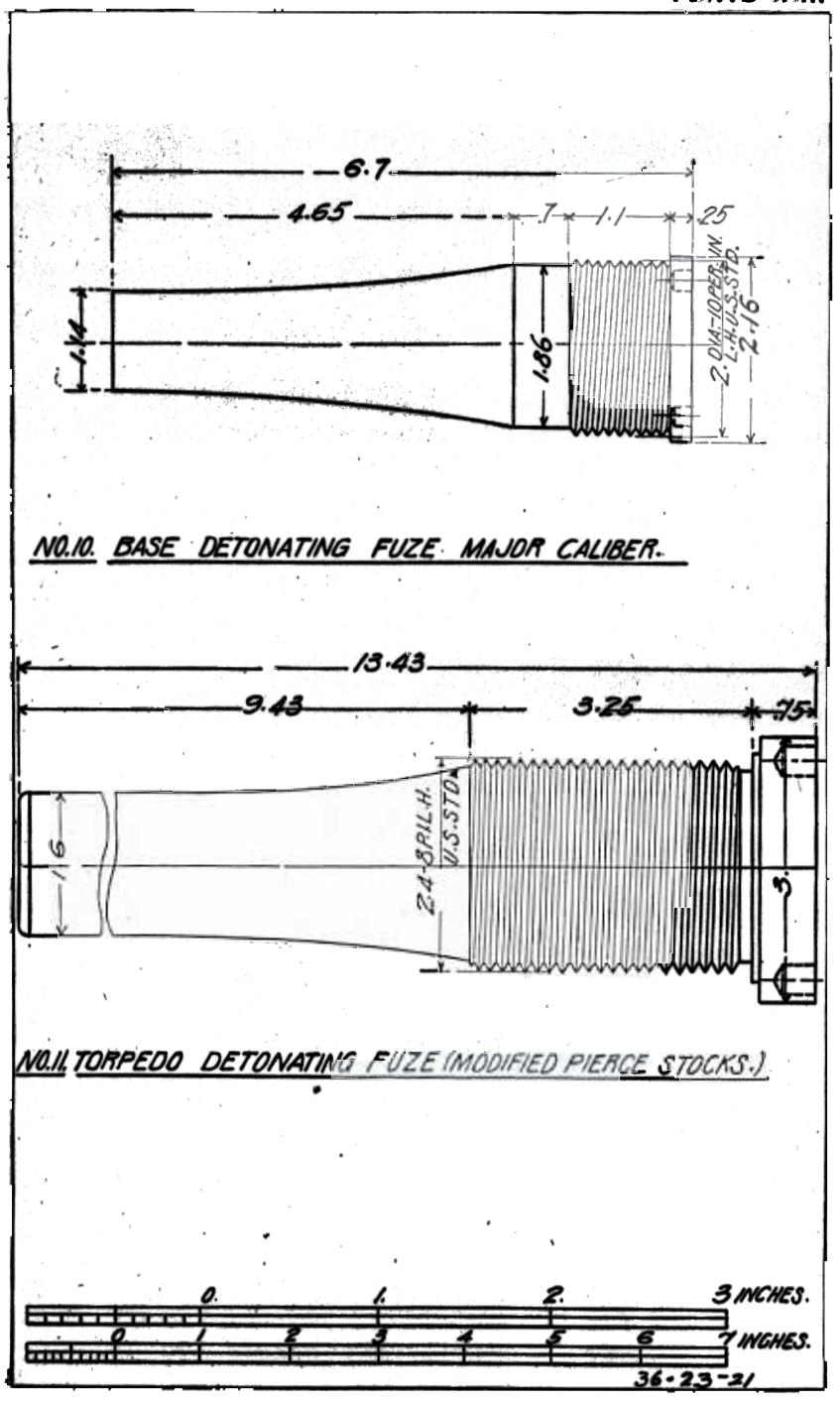


PLATE XXII

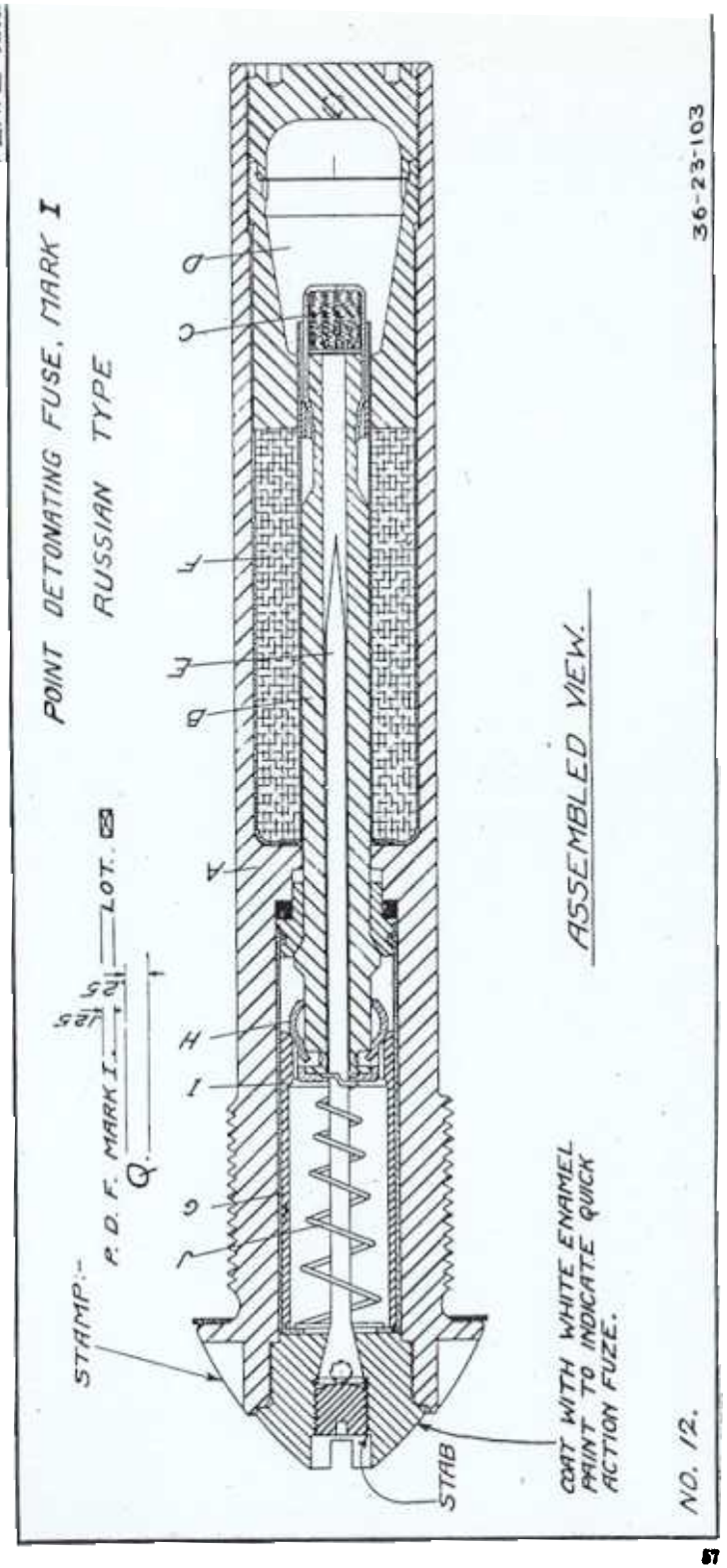


TABLE I.—*Ring-resistance fuzes*

Designation.	Diameter of thread.	Treads per inch.	Weight of sleeve.	Resistance to arming.	Value of ratio $\frac{W}{R}$	Weight of— Plunger.	Weight of— Assembled fuze.	Height of drop to arm.	Projectiles in which used and remarks
POINT INSERTION.									
Minor-caliber point percussion fuze, standard type.	0.722	18	*Grains.* 147	*Pounds.* 147	1.0	*Grains.* 205	*Ounces.* 2.3	*Feet.* 17.5 in 1-lb. shell.	1-pdr. point-fuzed shell of future manufacture.
Point percussion fuze for 1.457 V. M. gun ammunition.	.55	16.95	45	45	1.0				1.457 V. M. gun ammunition. About 40,000 of these fuzes of V. M. manufacture are on hand.
Point percussion fuze for 1.65-in. shell of Hotchkiss manufacture.	.838	14	147	114	1.3	208	3.0	12 in 1.65-in. shell.	1.65-in. point-fuzed shell of Hotchkiss manufacture. About 3,800 of these fuzes have been manufactured; obsolete.
Point percussion fuze for 1.65-in. shell of Winchester Repeating Arms Co. manufacture.	.722	18	147	114	1.3	208	1.9	12 in 1.65-in. shell.	1.65-in. point-fuzed shell of Winchester Repeating Arms Co. manufacture. About 4,600 of these fuzes have been manufactured; obsolete.
Point percussion fuze for 1.65-in. shell, former standard type	.779	16	165	126	1.21	234	2.125	15 in 1.65-in. shell.	1.65-in. point-fuzed shell to the number of about 5,000. The manufacture of this type is discontinued; obsolete.
BASE INSERTION.									
Minor-caliber base percussion fuze, standard type.	.875	14	165	165	1.0	237	4.0	17 in 1-pdr. shell.	2.38-in. and 2.24-in. powder-charged shell of future manufacture tapped for base fuze; obsolete.
Base percussion fuze for 1.65-in. shell, standard type.	.722	18	165	165	1.0	237	2.1	12 in 1.65-in. shell.	1.65-in. base-fuzed, powder-charged shell. About 25,000 have been manufactured for that number of 1.65-in. shell; obsolete.
Base percussion fuze for 1-lb. shell, former type.	.722	18	95	80	1.2	159	1.9	14 in 1-lb. shell.	1-pdr. base-fuzed shell. None on hand; obsolete.
Base percussion fuzes B and C, model of 1893–4.	.875	14					4.88		3.2 and 3.6 in. gun powder-charged shell; obsolete.
Base percussion fuze M, model of 1893–4.	.875	14					4.88		3.6-in. mortar powder-charged shell; obsolete.
Base percussion fuze, "High C," modified.	.875	14	266	138	1.92	357	3.9	17 in 15-pdr. shell.	3, 3.2, and 3.6 in. rifle powder-charged shell. It may also be used in siege detonating fuze, Peirce stock; obsolete.
Base percussion fuze, "High A"	1.125	12	715	222	3.22	850	8.2	5 in 45-lb. shell.	An obsolete type. A few in service in 7-in. howitzer powder-charged shell.
Base percussion fuze, medium and major caliber.	1.5	12	464	220	2.11	549	15.6	13 in 15-lb. shell.	Powder-charged shell from 2.95 to 7 in., inclusive, when used in guns giving high accelerations. Superseded by similar fuze having Semple centrifugal plunger.
Modified Driggs-Seabury base percussion fuze.		18	165	165	1.0		2.27		2.24-in. powder-charged shell tapped to take this fuze; 3,761 on hand; obsolete.
Modified American Ordnance Co. base percussion fuze.	.722		105	105	1.0	59	2.25		2.24-in. powder-charged shell tapped to take this fuze; 136 on hand; obsolete.

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TABLE II.—*Centrifugal fuzes.*

Designation.	Diameter of thread.	Threads per inch.	Revolutions per minute to arm.	Weight of plunger.	Weight of fuze assembled.	Projectiles and denotating fuzes in which used
				Grains.	*Lbs.* *oz.*	
"F" fuze; "link lift"	0.875	14	3,500	261	0 4.3	Siege detonating (S. D.) Peirce fuze stocks for 5 to 7 in. st tapped for this fuze stock to the number of 9,500; obsol
Base percussion fuze, medium and major caliber, "link lift" type.	1.5	12	2,000	513	0 15.6	Powder-charged shell from 2.95 to 12 in., inclusive; obsolete. superseded by Semple plunger type.
12-M fuze, "link lift" design	5	12	1,300	1,500	1 1.125	Torpedo detonating (T. D.) Peirce fuze stocks for 12-in. torpedo shell tapped for this fuze to the number of about 2,200. These fuzes will probably be withdrawn; obsolete. 3,404 12-M fuzes were manufactured for use in a like number of A. P. detonating fuzes, Peirce stocks, which have been altered therefor. These 12-M fuzes are now being withdrawn.
Base percussion fuze, medium and major caliber, Semple plunger type.	5	12	1,300 1,500 2,000	900	15.25	Powder-charged shell from 2.95 to 12 in., inclusive.

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TABLE III.—*Combination fuzes.*

Designation.	Diameter of thread.	Threads per inch.	Weight of assembled fuze.	Weight of time plunger.	Resistance to arming time plunger.	Value of ratio $\frac{W}{R}$ time plunger.	Weight of percussion plunger sleeve.	Resistance to arming percussion plunger.	Value of ratio $\frac{W}{R}$ percussion plunger.	Projectiles in which used, and remarks
			Lbs. oz.	*Grains.*	*Pounds.*		*Grains.*	*Pounds.*		
15-second combination fuze	1.18	8	1 1.5	200	35	5.71	235	111	2.11	3.2 and 3.6 in. field-gun and 5-in. siege-gun shrapnel on hand; obsolete.
28-second combination fuze, "high resistance."	1.18	8	1 2	200	15	13.33	248	75	3.30	3.6-in. mortar and 7-in. howitzer shrapnel on hand; obsolete. Is being replaced by a special 45-sec. fuze in 7-in. howitzer shrapnel.
28-second combination fuze, "low resistance."	1.18	8	1 2	200	15	13.33	248	32	7.75	7-in. mortar shrapnel on hand; obsolete.
Frankford Arsenal 21-second combination fuze, former type.	1.70	14	1 4	128	75	1.7	308	210	1.4	2.95 in. mountain, 3-in. field gun shrapnel. About 15,000 of these fuzes carry a centrifugal percussion plunger arming at 2,500 r. p. m.; obsolete.
Frankford Arsenal 21-second combination fuze, model of 1907M.	1.70	14	1 4	128	73	1.7	Centrifugal plunger.			Shrapnel for 2.95-in. mountain gun and 3-in. field gun.
Frankford Arsenal 30-second combination fuze, model of 1911.	1.70	14	1 4	156	19.5	8.0	Centrifugal plunger.			Shrapnel for 3-in. mountain howitzer and all 4.72 Armstrong 5-in. seacoast and 6-in. Armstrong shrapnel on hand or ordered prior to Jan. 1, 1914.
Ehrhardt 20.4-second combination fuze for 3-in. H. E. shrapnel.	.....	.....	3 8	.....	.....	.....	Bore safety pellet.			Ehrhardt 3-in. H. E. shrapnel, 10,000 on hand and 10,000 additional ordered.
Frankford Arsenal 21-second combination fuze for 3-in. H. E. shrapnel, model of 1912.	2.7	20	3 10.3	128	73	1.7	Bore safety pellet.			Frankford Arsenal 3-in. H. E. shrapnel.
Ehrhardt combination fuze	1.70	14	1 2½	110	90	1.22	215	.....	.....	3-in. field shrapnel. About 10,000 of these fuzes were purchased from the Ehrhardt Company; obsolete. Supply exhausted.
Krupp combination fuze	1.70	14	1 2.2	142	190	.70	124	177	.70	3-in. field shrapnel. About 10,000 of these fuzes were purchased from the Krupp Company; obsolete. Supply exhausted.
Frankford Arsenal 31-second combination fuze.[1]	1.70	14	2 0	160	20	8.0	Centrifugal plunger.			Shrapnel for 3.8-in. and 4.7-in. guns.
				310	31	10.0	Centrifugal plunger.			Shrapnel for 3.8-in., 4.7-in., and 6-in. howitzers.

[1] This fuze, with a slow-burning time train composition, to give a time of burning of about 45 seconds, is being assembled in a considerable number of 5-in. siege-gun and 7-in. siege-howitzer shrapnel.

TABLE IV.—*Detonating fuzes for use in steel projectiles containing a bursting charge of high explosive.*

No.	Designation of fuze.	Diameter of thread of fuze.	Number of threads per inch.	Weight of fuze.	Projectiles in which used.
		Inches.		*Pounds.*	
1	Mine-caliber base detonating fuze.	0.875	14	0.27	For use in 6-pdr. and 2.36-in. steel shell containing a bursting charge of trinitro toluol.
2	Field-point detonating fuze (F. D.).	1.3	12	.96	For use in steel shell for 3-in. field gun tapped in the point for this fuze. 1,000 of them have been manufactured and 722 are still on hand. No more of these fuzes will be manufactured.
3	Point detonating fuze for mobile artillery.	1.5	12	1.21	For use in steel shell for 3-in. field gun tapped in the point of this fuze. 8,000 of them have been manufactured for that number of steel shell now on hand. No more of these fuzes will be manufactured. Modified.
4	Special "S" base fuze with 100-grain detonator.	1.123	12	.65	For use in steel shell for 3-in. R. F. gun tapped in the base for this fuze. 14,000 of them have been manufactured for that number of steel shell on hand. No more of these fuzes will be manufactured and those in existence will be replaced by the medium-caliber base detonating fuze which has superseded this type.
5	Base detonating fuze for minor-caliber projectiles.	1.5	12	1.22	For use in steel shell for 3-in. R. F. gun tapped in the base for this fuze. 2,100 have been made for that number of 3-in. steel shell. No more of these fuzes will be manufactured and those in existence will be replaced by the medium-caliber base detonating fuze which has superseded this type.
6	Medium-caliber base detonating fuze.	1.5	12	1.39	For use in all steel projectiles from 2.95 to 7-in. in caliber, inclusive. Superseding other fuzes for use in these projectiles when the present stock has been exhausted and when specially ordered.
7	Base detonating fuze for medium-caliber projectiles.	1.5	12	2.18	222 of these fuzes only have been manufactured for use in that number of 4-in. Driggs-Schroeder common steel shell. No more of these fuzes will be manufactured. Superseded by medium-caliber detonating fuze. These fuzes were provided with ring-resistance plungers.
8	Siege base detonating fuze (modified Pettes stock).	1.5	12	1.90	For use in steel projectiles of from 5-in. to 7-in. caliber adapted to this fuze until the stock of fuzes on hand (about 9,500) has been exhausted. No more of these fuzes will be manufactured. Superseded by medium-caliber detonating fuze.
9	Armor-piercing base detonating fuze (modified Pettes stock).	2.4	8	6.9	For use in 8, 10, and 12 in. gun shell and in 12-in. mortar shell adapted to this fuze until the stock of fuzes on hand (about 10,000) has been exhausted. No more of these fuzes will be manufactured. Superseded by mine-caliber detonating fuze. 30024 B15-925. These fuzes are being modified so as to be similar to the major-caliber base detonating fuze, but will not fit in same seat in base plug.

TABLE IV.—*Detonating fuzes for use in steel projectiles containing a bursting charge of high explosive*—Continued.

No.	Designation of fuze.	Diameter of thread of fuze.	Number of threads per inch.	Weight of fuze.	Projectiles in which used.
		Inches.		*Pounds.*	
10	Major-caliber base detonating fuze.	2.0	10	3.04	For use in steel projectiles over 7-in. cal., superseding all other types of fuzes in these projectiles when the stock on hand has been exhausted.
11	Torpedo base detonating fuze (modified Peirce stock).	2.4	8	8.0	For use in 12-in. mortar steel shell on hand until the stock on hand (about 2,200) has been exhausted. No more will be manufactured. Superseded by major-caliber detonating fuze. These fuzes will be modified so as to be identical with A. P. detonating fuzes.
12	Point detonating fuze Mark 1, Russian type.	.....	.....	.....	3-inch field gun shell fitted for point detonating fuze.

NOTE.—Base fuzed shell for 3-in. field guns have all been fitted with medium-caliber base detonating fuzes having Semple centrifugal plungers.

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